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FUELWOOD CONSUMPTION IN NEWFOUNDLAND

NORTHLAND ASSOCIATES LIMITED
ST. JOHN'S, NEWFOUNDLAND

NEWFOUNDLAND FOREST RESEARCH CENTRE
Information Report N-X-177

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FUELWOOD CONSUMPTION IN NEWFOUNDLAND

(ENFOR Project P-2, DSS File No. 07SC. KL001-7-0114)

Prepared for

ENFOR Secretariat
Canadian Forestry Service
Department of Environment
Ottawa, Ontario
K1A 0E7

by

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NEWFOUNDLAND FOREST RESEARCH CENTRE
INFORMATION REPORT N-X-177

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FOREWORD

ENFOR is the bilingual acronym for the Canadian Forestry Service's ENergy from the FORest (ÉNergie de la FORÊT) program of research and development aimed at securing the knowledge and technical competence to facilitate in the medium to long-term a greatly increased contribution from forest biomass to our nation's primary energy production. This program is part of a much larger federal government initiative to promote the development and use of renewable energy as a means of reducing our dependence on petroleum and other non-renewable energy sources.

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ENFOR Secretariat
Canadian Forestry Service
Department of the Environment
Ottawa, Ontario
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This report, based on ENFOR project P-2, was produced under contract (DSS File No. 07SC. KL001-7-0114) by NORTHLAND ASSOCIATES Ltd., St. John's, Newfoundland.

The report was reviewed by a number of agencies after it was received from Northland Associates Limited. One reviewer pointed out that the methodology used in some of the calculations led to an overestimate of the number of serious wood burning households in some cases. The relevant excerpt from the comment is as follows:

"The areas of the island that were sampled consisted of 15 populated forest management units. In each of these units, forestry officials were consulted regarding the local fuelwood consumption patterns. As a result of these discussions, the towns thought to have similar consumption rates within the unit were grouped into divisions. The proportion of serious wood burners within each division in 1977-78 was obtained by dividing the number of serious wood burners by the number of households sampled. Proportions were then extrapolated to the total population of the division. Divisional estimates were then totalled to give an estimate of the total number of wood burners in each management unit.

The important assumption is therefore that consumption patterns within a division are similar to the point where it is considered valid to group

the towns accordingly. Because more than one town was sampled in twelve of the divisions, this assumption can be tested. If the proportion ($\hat{p}$) of serious wood burners is approximately constant from town to town within a division, then extrapolation to the total number of households in the division shall be valid based on simply adding together the responses for the various towns. However, if $\hat{p}$ differs significantly from town to town, then estimates of households will be biased unless proper weighting is attributed to each town."

Recalculation of the estimated number of serious wood burning households using the weighting procedure suggested above indicated that there was an overestimate of the number of serious wood burning households in 10 of the 12 sampling divisions that could be checked. The remaining 42 sampling divisions could not be checked because they contained only one town. The report estimates and the revised estimates of the number of serious wood burners for the 12 divisions that could be checked are summarized in the following table:

Summary of original and revised estimates of number of serious wood burners for 12 survey divisions.

Management Unit	Sampling Division	Serious wood burners	
		Original report estimate	Revised weighted estimate
1	2	6140	5498
1	3	909	866
2	3	3074	2847
7	3	318	298
9	5	211	204
10,11,12	2	651	639
14	2	1495	1493
15	4	563	565
17	1	349	323
18	2	199	199
18	3	668	612
18	4	41	34
Totals:		14,618	13,578

Using the weighting procedure, a lower overall estimate of the number of serious wood burners is obtained for the 12 survey divisions. This estimate is 93 percent of the unweighted estimate of the report. Assuming the same

percentage correction would apply to all divisions, the revised estimate of the number of serious wood burners for the Island for 1977-78 is 30,093 compared to 32,358 in the report. The revised estimate for the total volume of fuelwood consumed for 1977-78 is 429 261 stacked m^3 compared to 461 571 stacked m^3 in the report.

It should be noted that the volume estimates in the report include only wood consumed by individuals burning 3 stacked m^3 or more. A considerable number of households are known to burn quantities less than this, but these were not included in the survey. Thus, while the statistical methodology used may have led to an overestimate of the volume of wood consumed, the criteria used in the selection of households had the opposite effect in that the volume consumed by a large number of casual wood burners was omitted from the estimate.

The sampling and data analysis methodology was selected cooperatively by the consultant and the supervisory committee. The report which follows is presented esentially without change as received from the consultant.

- John Munro
Scientific Authority

ABSTRACT

Fuelwood consumption in Newfoundland was known to have declined considerably during the 1950's and 1960's as more and more people changed to cleaner and more efficient fuels for domestic heating and cooking purposes. This trend was reversed in the 1970's as costs of alternative fuels increased dramatically. While resource managers were aware of the trend towards increasing fuelwood consumption, there was no system in place to quantify, with any precision, the amount of wood being harvested for this purpose. This study was undertaken to get a first estimate of fuelwood consumption for the island of Newfoundland for the period April 1, 1977 to March 31, 1978.

The study was carried out in two main phases. In phase one, the consultant reviewed available literature and assessed the existing data collection systems on fuelwood consumption used by the various forestry agencies in the Province. As a result of this assessment, it was decided to implement phase two which consisted of a personal interview telephone survey on fuelwood use for most parts of the Island which had access to wood supplies.

Householders were asked questions on how much wood they burned, when they started burning wood, type of wood burning unit used, other sources of heat used, reasons for burning wood, employment, distance travelled to obtain wood and expected consumption in 1978-79 compared to 1977-78. It was found that the estimated number of households burning wood increased from about 22,000 before 1973 to approximately 32,000 in 1977-78. There was a further estimated increase to about 39,500 in 1978-79. In 1977-78, it was estimated that 461,571 stacked cubic metres of fuelwood were consumed on the Island. This was broken down into 318 916 m^3 of softwood and 142 655 m^3 of hardwood.

Fuelwood consumption accounted for anywhere from 1 percent to 77 percent of the calculated allowable annual cut for the various forest management units on the Island for 1977-78. Overall, fuelwood consumption estimated by the survey accounted for 8 percent of the estimated allowable annual cut. Use of wood as fuel is expected to continue increasing and it is recommended that estimates of consumption be periodically updated so that forest management plans can make adequate provision for this demand in future.

Résumé

On sait que la consommation de bois de chauffage à Terre-Neuve a baissé considérablement dans les années cinquante et soixante, la raison de cette baisse étant que beaucoup de gens ont changé de combustible afin d'en avoir un plus efficace et plus propre pour le chauffage et la cuisine. Cette tendance a changé dans les années soixante-dix lorsque le prix des autres combustibles a augmenté de manière prodigieuse. Alors que les directeurs des ressources étaient conscients de cette tendance à revenir à la consommation du bois de chauffage, ils n'ont pas établi de système pour mesurer d'une manière précise la consommation totale de bois de chauffage pour l'Île de Terre-Neuve pendant la période du 1er avril 1977 au 31 mars 1978.

L'étude a été faite en deux phases: dans la première l'expert-conseil a révisé la littérature disponible et a évalué les systèmes déjà existants de collection des données sur la consommation de bois de chauffage, ces systèmes étant utilisés par les diffétentes organisations forestières de la Province. Comme résultat de cette évaluation, on a décidé de passer à la deuxième phase qui constistait en un sondage individuel par téléphone sur l'utilisation du bois de chauffage dans la plupart des régions de l'Île qui se servaient de bois.

On a posé des questions aux habitants sur la quantité de bois utilisée, à quel moment ils avaient commencé à se servir de bois, le genre de poële utilisé pour brûler ce bois les raisons pour lesquelles ils se servaient de bois, les autres sources de chaleur, leur emploi, la distance à parcourir pour aller chercher le bois et la consommation possible en 1978-79 comparée à celle de 1977-78. On a trouvé que le nombre approximatif de maisons utilisant du bois de chauffage était passe de 22,000 environ avant 1973 a 32,000 environ en 1977-78. Ce nombre irait jusqu'à 39,500 en 1978-79. On a estimé que 461,571 mètres-cubes de bois de chauffage ont été utilisés en 1977-78, ceci étant partagé en 318,916 m^3 de bois tendre et 142,655 m^3 de bois dur.

La consommation de bois de chauffage est responsable pour au moins un à xante-dix pour cent de la coupe annuelle autorisée dans les diverses forêts de l'ile de 1977 à 1978. D'une manière générale la consommation du bois de chauffage évaluée par le sondage formait huit pour cent de la coupe annuelle autorisée. On pense que l'utilisation du bois comme combustible va continuer à augmenter et on recommande que l'évaluation de la consommation soir révisée périodiquement afin que les directeurs des organisations forestières puissent établir des plans plus adéquats aux besoins futurs.

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ACKNOWLEDGMENTS

During the course of the study NORTHLAND ASSOCIATES received valuable assistance from a number of individuals. Foremost was the contract supervisory committee composed of Dr. John Munro (Canadian Forestry Service), Mr. G. Davis (Nfld. Dept. Forestry and Agriculture), and Mr. J. Meades (Canadian Forestry Service). Their advice and constructive criticisms helped maintain the course the study followed, as well as the weighing of results.

All provincial forest management unit staff contacted provided knowledgeable insights into some aspects of the fuelwood consumption patterns in their respective units. Without this information and insight we could not have properly assessed the domestic cutting permit system or designed a valid sampling program.

A number of other individuals gave of their experience and knowledge. They are: Mr. Peter Grimes (Golden Eagle Canada Ltd.), Mr. Dave Bradbury (Gulf Oil Canada Ltd.), Mr. Paul Bugden (Newfoundland Department of Mines and Energy), Marc Schneider (University of New Brunswick), Mr. Bill Trask (Newfoundland Light and Power). Mr. Doug Furlong (Newfoundland Department of Forestry and Agriculture) assisted K. Sutton of NORTHLAND in determining conversion factors for pick-up truck loads to cords. The office of Statistics Canada in St. John's and Ottawa, provided data and sound advice on sample design.

Mr. Mark Shrimpton, Research Associate with the Institute of Social and Economic Research, Memorial University of Newfoundland provided advice on the selection methods for sample towns and households.

Mr. Alton Greene (Newfoundland Department of Forestry and Agriculture) provided forest inventory data and advice on the interpretation of that data. The forestry staff of Unit 2 provided some logistical support and field assistance in the scaling of firewood.

We gratefully acknowledge the assistance of the foregoing persons and groups.

The study team members and their areas of responsibility are indicated below:

B. Boles	Project management, report writing
K. Sutton	Field sampling, data gathering, report writing
G. Campbell	Sample design, data analysis, report writing

CONVERSION FACTORS

All volumes are reported in stacked cubic metres.

1 CORD	=	3.62456 m^3
1 PICK-UP TRUCK LOAD OF WOOD (HARD OR SOFT)	=	.4 CORDS = 1.45 m^3
1 CUNIT	=	4.26 m^3
1 BRITISH THERMAL UNIT	=	1.05506 Kilojoules
1 MILE	=	1.60934 km

1.0 INTRODUCTION

Fuelwood has always been a traditional source of energy in Newfoundland. The rate of use probably leveled off or declined with the increased urbanization of the population in the 1950's and 1960's, and with a more readily available cheap supply of fuel oil and electricity. When the price of oil and electricity began its dramatic rise in the 1970's it produced an incentive towards an increased use in fuelwood for domestic heating. This led local forestry officials to the realization that the magnitude of the increase should be quantified in order to provide more precise information on wood consumption for forest management planning purposes.

NORTHLAND ASSOCIATES Ltd. was awarded a contract on May 30, 1978 to assess the fuelwood consumption on the island of Newfoundland. The contract was let and supervised by the Canadian Forestry Service (CFS) in St. John's as part of its responsibilities to the Sawmill and Wood Products Development Advisory Committee and to the Department of Forestry and Agriculture. Funding for the study was provided by the CFS Energy from the Forest (ENFOR) program of research and development.

A brief summary of the objectives is shown below. (The complete statement of work is shown in Appendix 1.)

(1) Estimate the volume of fuelwood consumed in 1977, and estimate the past 5 year trend in fuelwood consumption. The kinds of wood consumed (i.e. hardwood and softwood, roundwood and mill residues) were to be indicated to the extent possible.

(2) Describe the trend in the rate of substitution of wood for oil and electricity at alternative price levels and the possible effects of increases in the price of these fuels on the future demand for firewood.

(3) Project the fuelwood consumption for the next five years.

NORTHLAND carried out the study in two phases. Phase I consisted of a review of the existing literature and a search for available fuelwood statistics. It became apparent after Phase I that some of the objectives of the study could not be met due to a lack of reliable historical data at the forestry offices. For example, we could not attempt to establish historical trends in the volume of fuelwood consumed but instead established trends in the number of new wood burning households. Also, the volume of sawmill residues consumed for firewood could not be determined since (1) sawmillers could not estimate the volumes given away or sold for firewood

(2) householders could not gauge the quantities consumed with a reasonable degree of reliability. Finally, fuelwood consumption projections for the years 1978-83 could not be made since the previous five year statistics were unavailable.

Phase II consisted of designing and carrying out a survey to obtain fuelwood consumption statistics for the island. Ancillary information on wood burning habits was also collected in Phase II.

2.0 PHASE 1 - LITERATURE REVIEWS AND ASSESSMENT OF EXISTING DATA SOURCES

2.1 Introduction

The objectives of Phase 1 were to determine, where possible, what data presently existed which might be used to determine fuelwood consumption rates and trends and, to review procedures used in other regions to determine such information. The identification of local data gaps was an integral part of this phase since these gaps would greatly influence the way in which Phase 11 would be conducted.

Various federal, provincial and state agencies were contacted regarding fuelwood consumption surveys. The provincial government forest management unit offices throughout Newfoundland were visited and discussions were held with the unit personnel. Bowater Newfoundland Ltd. and Abititi-Price Ltd. offices were visited and discussions were held with appropriate company representatives. Atmospheric Environment Service, Newfoundland and Labrador Hydro, Nfld. Light and Power Co. Ltd., the provincial Department of Mines and Energy, wood stove sales outlets and the fuel oil supply companies were contacted regarding additional information. Addresses for the contacts made during this phase of the survey are listed in Appendix 2.

2.2 Literature Review

The fuelwood consumption literature is not extensive. In many cases, the literature that was available was geographically and culturally inappropriate for the needs of this study. A summary of the material reviewed, plus identification of the sources from which it came, follows.

Canada

Federal Agencies

(1) Data Base Services (Fisheries and Environment Canada) Ottawa.

Library searches were carried out by Data Base Services. These searches revealed that some consumption surveys had been carried out in the underdeveloped countries. However, these surveys were of minimal use because of the different biological, climatological and cultural situation in Newfoundland. In the underdeveloped countries fuelwood accounts for 86 percent of the total wood removals (Arnold and Jongma, 1978). This, coupled with limited energy supplies makes fuelwood a very important commodity. Fuelwood consumption surveys were very intense and covered only small areas. We were interested in determining consumption in a relatively large area, therefore the methods used in underdeveloped countries could not be applied in Newfoundland.

(2) Statistics Canada publishes annual statistics on fuelwood cutting in the various provinces (Anon., 1972-78). Included are estimates made by the Newfoundland Forest Service and adjusted by Statistics Canada.

Statistics Canada publishes an annual report entitled "Household Facilities and Equipment," which includes Newfoundland (Anon., 1977-78). The data for heating appliances in these reports were too general for use in satisfying any of the objectives of this study.

Provinces

Officials in Nova Scotia, P.E.I., New Brunswick, and Ontario were written, and replies received indicated a paucity of information on domestic firewood consumption surveys.

U.S.A.

The north and northeastern states were contacted regarding fuelwood consumption surveys. Maine, Massachusetts, Michigan, Minnesota, New York, Pennsylvania and Wisconsin generally indicated an increased awareness in fuelwood consumption and interest in fuelwood surveys. An in-depth survey on fuelwood use and procurement has been undertaken in New Hampshire but the methodology was not fully applicable to the Newfoundland situation (Dalton et al., 1977).

2.3 Newfoundland Fuelwood Permit System

The island of Newfoundland is divided into 18 forest management units and three forestry regions for provincial forestry administrative purposes (Figure 1). Provincial forestry officials are responsible for issuing permits for all commercial cutting

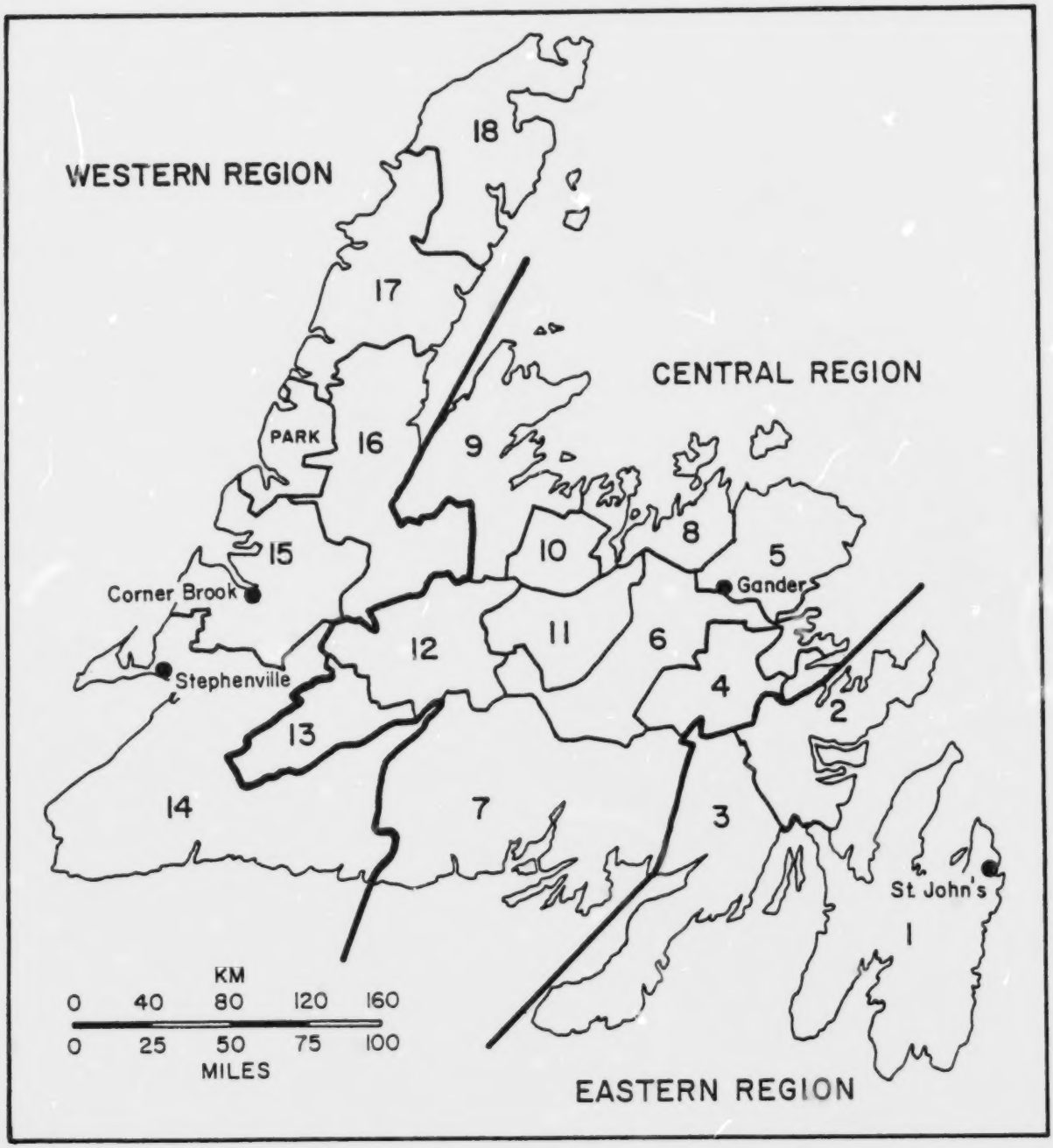

Figure 1. Newfoundland forest management units and administrative regions. (From Dept. of For. & Agric.)

on crown land within these units and for both commercial and domestic cutting in the units containing legislated forest management areas. It should be noted that some units do not yet contain legislated forest management areas.

A nominal fee of $2.00 is charged for a permit to cut firewood for one's own needs and the permit holder can cut approximately 43 stacked cubic metres (12 cords) from crown land without paying stumpage fees. Permit holders are required to make returns at the end of the year stating the volume of wood that they cut. Theoretically these domestic permit returns should enable the forestry service to make estimates for fuelwood consumption volumes on only a small portion of the island.

2.3.1 Data Gaps in Permit System

The forestry management units containing crown lands were visited in June, 1978. Conversations were held with the unit personnel regarding fuelwood consumption and available statistics. These discussions revealed many gaps in the historical fuelwood statistics for the management units.

The policies followed in issuing domestic cutting permits were not totally consistent, but in general, it may be said that in special areas legislated as forest management areas within the forest management units people were forced to obtain domestic cutting permits while in other areas within the forest management units permits were issued in some cases, but the system could not be enforced.

A large portion of Newfoundland forests are controlled by pulp and paper companies, or other private interests (Figure 2). There are virtually no fuelwood cutting statistics available for privately held limits since in most cases records are not kept for fuelwood removal. The forest management units controlled by the companies are Numbers 4, 6, 10 and 11-13. Other units containing some company limits are Numbers 5, 7-9, 14-16, 17 and 18. From this it can be seen that there is no fuelwood cutting data for a large part of the island.

2.4 Fuel Oil, Electric Heating and Stove Data for Insular Newfoundland

All major fuel oil supply companies in Newfoundland were contacted and detailed discussions were held with two companies, Golden Eagle Canada Ltd, and Gulf Canada Ltd. These companies were contacted in order to obtain and evaluate information on historical fuel oil sales that might be useful in predicting fuelwood consumption trends.

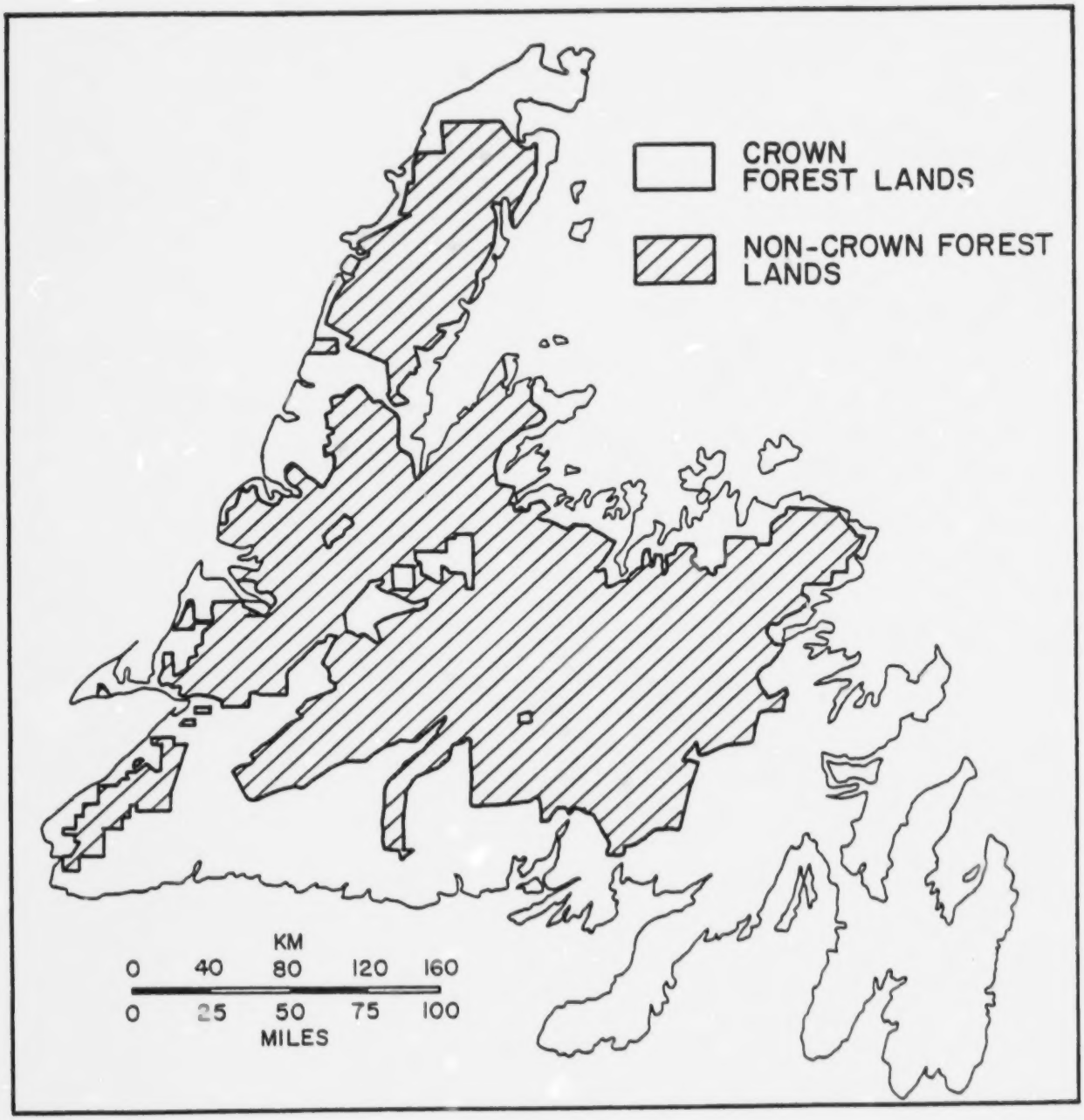

Figure 2. Major tracts of crown and non-crown forest lands in insular Newfoundland.

Oil supply companies usually have detailed consumption data for their various sales regions. In some cases either the company or the local distributor has records at the household level for fuel oil consumption. The accessibility of this data for any publicly sponsored and reported heat energy studies in general is doubtful, due to inter-company competition. In addition, its usefulness is minimal for determining fuelwood consumption estimates because of the variability in the insulative materials used in houses and the personal preferences and habits of each household.

It was reported that in some regions, oil consumption had declined. This was accredited by the oil companies to a combination of factors which included increased cost, improved and additional home insulation, conservation practices, climatic variation, increased fuelwood utilization and unemployment rates.

Newfoundland Light and Power Co. Ltd. provided data on the type of heating unit installed in customers' houses obtaining new electric connections for the period 1972-78. Examination of some of this data (Figure 3) illustrated that there had been a switch in preference from installing electric heat systems to utilizing some other heat source(s). Logically, these must have been fuel oil and/or wood burning appliances. In rural and urban areas the reversal for rural areas was more rapid than for urban areas. It was impossible to determine whether or not this was due to more readily available "cheap" alternate energy (such as fuelwood) or some other factor.

Information on the number and types of heating systems is very unreliable in providing woodfuel consumption estimates. Schneider (in a letter to one of the authors in 1978) stated that "all heating systems operate on a demand basis, and therefore knowing system capacity tells little about the amount of heat delivered. In addition, with wood heating systems efficiencies are quite variable, so that even if demand were known, fuelwood consumption might not be. Also, unfortunately, very few wood heating systems are calibrated as to maximum heat output in any meaningful way. Even if you did have a reliable estimate of types and numbers of heating systems in Newfoundland, and if you were able to put a capacity on each type, still all you would have would be an estimated Newfoundland domestic heating capacity. Such a figure would have no more use in predicting fuelwood consumption than would total sawmill capacity in predicting sawtimber consumption or pulp mill capacity in determining pulpwood consumption."

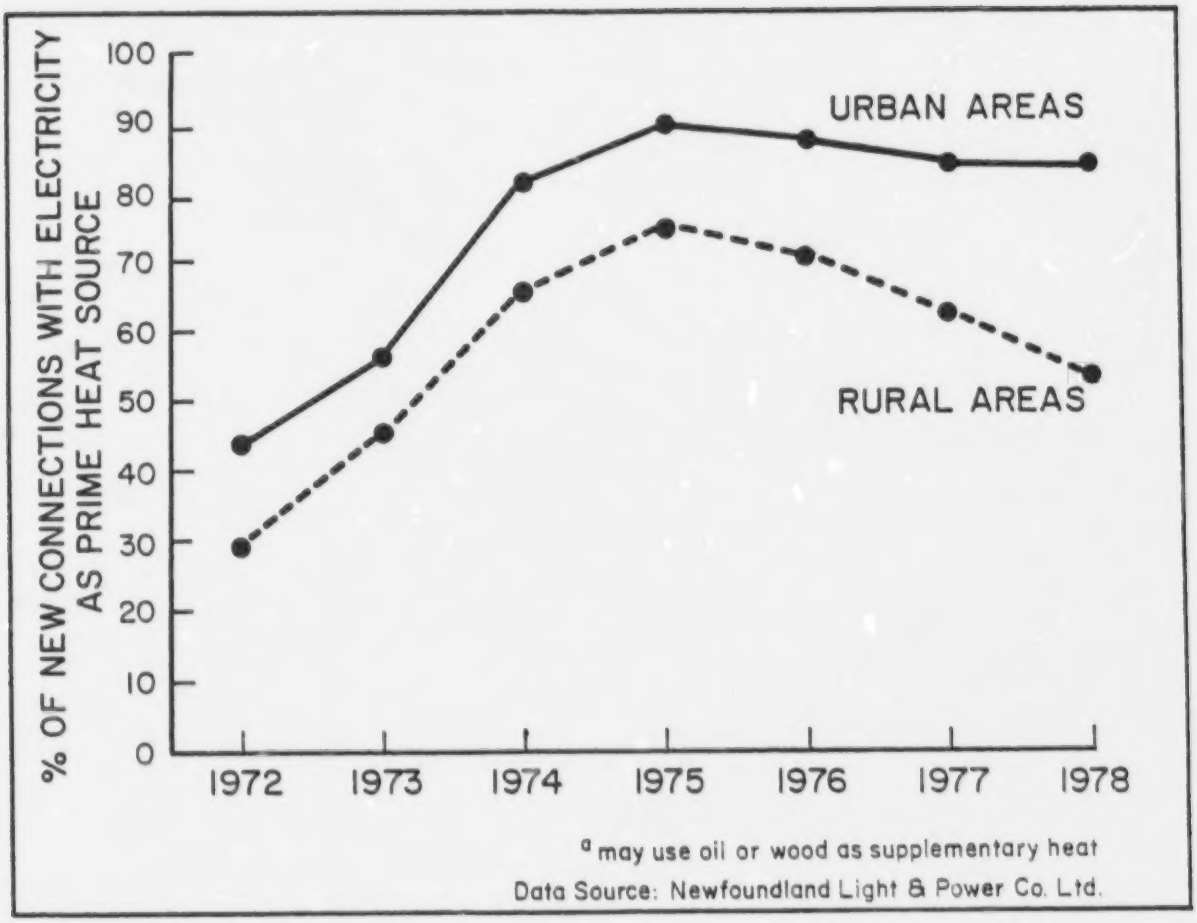

Figure 3. Urban and rural trend in utilization of electric heat as prime[a] source for households.

2.5 Summary

We found only one fuelwood consumption survey that had been completed in northeastern North America. The design of this survey was not suitable for a Newfoundland fuelwood consumption survey. The provincial cutting permit statistics had too many large gaps to be of much use in fulfilling the study's objective. A large portion of the island is not represented by cutting permit returns because these forests are alienated lands or are not legislated management areas and the domestic permit system is not enforced. The utilization of fuel oil or electric heating installation trends would not provide any fuelwood consumption data. Wood burning appliance sales data are inadequate for determining woodfuel consumption volumes, but the trend to purchase wood stoves is reported to be increasing rapidly in Newfoundland.

2.6 Conclusion

In order to determine detailed fuelwood consumption volumes and trends, a survey of wood burning households had to be undertaken to fulfill the main objectives of the survey.

3.0 PHASE 2 - COLLECTION OF FUELWOOD CONSUMPTION DATA AND DATA ANALYSIS

3.1 Introduction

As previously noted there was inadequate data available in government files to provide a realistic estimation of the volumes and the rate of increase in the use of fuelwood. It was decided, by NORTHLAND ASSOCIATES Ltd. in conjunction with the Supervisory Committee, to conduct a survey of the entire island. The objective was to collect the necessary data to estimate fuelwood consumption volumes and trends in use. Ancillary data covering other questions such as type of wood burning unit, wood burning history of households, and distance travelled for wood, were also collected during the survey.

The areas surveyed involved only the 15 populated forest management units, that is Unit Numbers 1-3, 5, 7-12, 14-18. Fuelwood cutting in Units 4, 6, and 13 was considered negligible. Fogo Island, Gros Morne National Park, and the communities between Fox Roost and Burgeo in Unit 14 were not sampled. The Port aux Basques area in Unit 14 and the St. John's and surrounding areas in Unit 1 were sampled, but the sample size was considered too small for use in obtaining reliable estimates. Sample size for these areas was not increased because of funding constraints.

3.2 Survey Methods

The original survey method involved telephone interviews followed by more detailed interviews at the homes of the householders. This was later changed to a more detailed telephone interview type survey only. Visiting householders was very time-consuming so it was necessary to either obtain all the required information by phone or decrease the sampling intensity. Since it appeared that the householders felt more relaxed and cooperative in the telephone interview, it was decided to eliminate the personal interviews at the household.

Sampling intensity, sample size, question design, etc., were determined after consultation with regional forestry personnel, Statistics Canada and other specialists in sampling design.

A questionnaire was designed and field-tested in six communities in Unit 2 (Bonavista Peninsula). Based on this experience questions were deleted or reworded so as to remove bias and confusing phrases. An example of the final questionnaire developed is shown in Appendix 3.

3.3 Sample Design

Selection of Communities for Sampling

In each unit forestry officials were consulted regarding the local fuelwood consumption pattern. As a result of these discussions the towns thought to have similar consumption rates within the unit were grouped into divisions. These towns and divisions are listed in Appendix 4. The divisions within the units are shown in Figure 4. The number of communities sampled in the units varied from 1 to 8, depending on the number of divisions and the number of communities within a given unit. The selection within a division was made by numbering all towns and then selecting at random the towns to be sampled. The larger towns (usually only one) within each management unit were automatically included for sampling since the consumption patterns within these large centres of population were considered to be different from the rest of the unit. Table 1 lists the 75 towns sampled within the 15 management units surveyed.

Sampling Within Communities

Where practical an attempt was made to contact at least 40 households in each community. The number of households contacted in the communities ranged from 12 to 106. In towns with less than 40 households, an attempt was made to contact all the households. In some of the medium-sized towns (e.g., Springdale and Baie Verte) approximately 50 households were contacted. In relatively large centres such as St. John's, Corner Brook, Grand Falls, and Gander, 100 or more

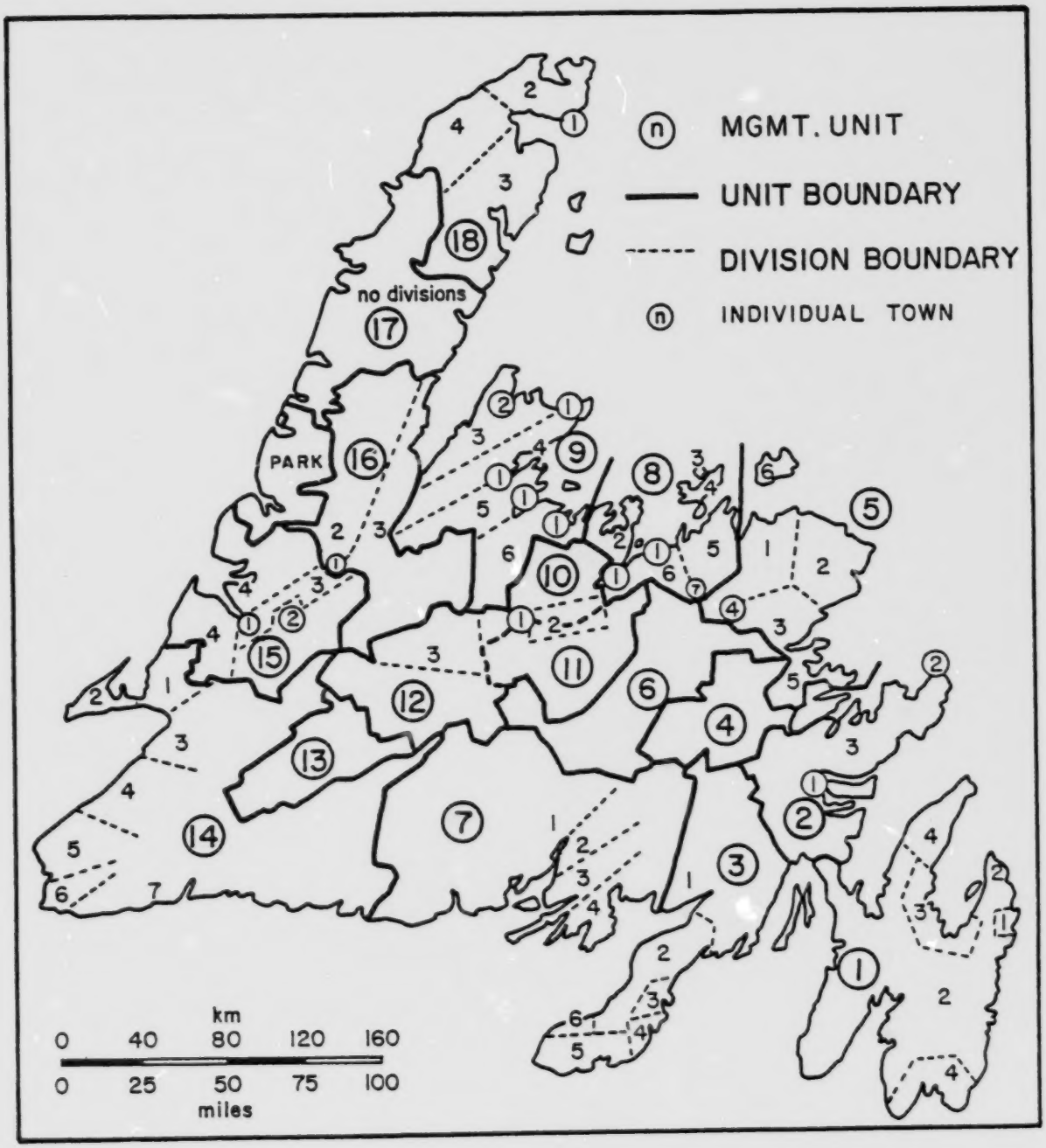

Figure 4. Forest management units and firewood consumption divisions within these units.

households were contacted. Appendix 5 lists the number of people phoned and the number contacted within each town sampled.

The householders phoned were chosen from the most recent telephone directories. The names of the households were numbered consecutively in the telephone directory and the people phoned were chosen by using random number tables. In larger towns, pages of the directory were chosen randomly and names were selected from the pages systematically. Lists of householders to be phoned were taken into the field and phone calls were usually made from within each unit. The interviewer phoned from the most convenient place within the units to reduce long distance charges. All householders on the list were phoned at least once. In the case of a non-answer, a second phone call would normally be made if the first call was placed during the day. A second phone call was rarely made after a non-response from evening calls. It was assumed that in the evening a representative cross-section of the householders in the community were at home.

All householders contacted were asked if they burned firewood from April 1, 1977 to March 31, 1978, or intended to burn it or were burning it in 1978-79 in a serious way. "Serious" was defined as burning equal to or more than 3 m^3 of stacked wood (.8 cords) in a year. (This is equivalent to two pick-up trucks of wood.) Those burning less than 3 m^3 (stacked) in 1977-78 were considered "casual" burners. Those burning less than 3 m^3 (stacked) in 1978-79 were not recorded. The householders who started burning wood in 1978-79 and who intended to burn 3 m^3 (stacked) or more in that period were classified as "new" wood burners. In recording new wood burners, special care was taken to record only the householders who stated that they started, or were definitely intending to start, burning wood in 1978-79. Any respondent who stated that they "might be" going to burn wood was recorded as a non-wood burner for 1978-79.

The first seven serious wood burning households contacted in a sample community were interviewed in detail regarding their consumption of fuelwood and on a variety of other questions. Care was taken to ensure that the first seven serious wood burning households on the sample list were interviewed, so as not to bias the survey by using the responses of the first seven serious wood burners who happened to be at home to the phone calls. It was felt that such a bias might favour the unemployed or seasonal workers.

Table 1. Towns sampled in forest management units.

Management Unit 1

St. John's
Dildo
Jerseyside
St. Joseph's
Tors Cove
Chapel Cove
Seal Cove
Burnt Point

Management Unit 2

Clarenville/
Shoal Harbour
Bonavista
English Harbour
Goose Cove
Long Beach
Musgravetown

Management Unit 3

Terrenceville
Red Harbour
Marystown
Burin
Lord's Cove
Grand Bank

Management Unit 5

Aspen Cove/
Ladle Cove
Badger's Quay
Gambo/Dark Cove/
Middle Brook
Gander
Eastport

Management Unit 7

St. Alban's
Milltown
Hermitage
Pool's Cove
Harbour Breton

Management Unit 8

Botwood
Point of Bay
Twillingate Isld.
Hillgrade
Rodger's Cove
Stanhope
Glenwood/
Appleton

Management Unit 9

Springdale
Baie Verte
Brent's Cove
Nipper's Harbour
Harry's Harbour
Little Bay
Triton/Jim's Cove

Management Units 10, 11, 12

Badger
Bishops Falls
Grand Falls/Windsor
Millertown

Management Unit 14

Stephenville
De Grau
West Bay
Flat Bay
Robinson's
Woodville
Port aux Basques

Management Unit 15

Corner Brook
Pasadena
Little Rapids
Lark Harbour
Mount Moriah

Management Unit 16

Deer Lake
Cormack
Sop's Arm

Management Unit 17

Daniel's Harbour
Eddies Cove West
River of Ponds
Shoal Cove West

Management Unit 18

St. Anthony
Goose Cove East
Quirpon
Bide Arm
Conche
Anchor Point
Black Duck Cove

In some communities most of the interviews could be completed between 9 a.m. and 5 p.m. This tended to occur in communities where unemployment was high. In other communities where there was low unemployment, interviews had to be conducted between 5 p.m. and 9 p.m. in order to obtain responses. Seven complete interviews could not be obtained in some communities, usually because we could not contact seven wood burners who could give an estimate of volume consumed, or because we could not contact seven wood burners.

Volume data collected in the study were reported and recorded in cords in areas where people were familiar with this measure. In other areas where people were unfamiliar with the cord measure, consumption was usually reported in pick-up truck loads or by the number of turns (1 turn = 1 stick of wood 8' - 14' long) burned. Figures 5 and 6 show a turn of wood and a pick-up truck load of firewood. No one reported volumes in metric units. In the case where a volume was reported in cords and the interviewer felt that the respondent probably had no idea what a cord was, the respondent was asked to convert the volume of wood consumed from his cords to pick-up truck loads.

Pick-up truck loads, cords, and turns were the most popular measure of wood used by people. A conversion factor was required for converting pick-up truck loads to cords. Field scaling of pick-up truck loads of firewood was undertaken and a factor of 0.4 cords per average pick-up truck load determined. Thereafter all volumes reported in the interviews in pick-up truck loads were converted to cords using this factor. The appropriate conversion factors for converting turns to cords were decided on after consultation with the forestry officials in the units.

Firewood could not be scaled during the study for the following reasons:

(1) We were determining fuelwood consumption for the fiscal year 1977-78 while the survey was being carried out in the fiscal year 1978-79 when the wood had already been burned.

(2) Many people did not have a full year's supply of firewood on hand at any one time.

(3) Some people always had two or three year's supply of fuelwood on hand but it was impossible to accurately scale the volume they would burn in one year.

The only way to get around this problem was to ask people how much firewood they burned and then take the various measures they used and convert them to cords.

Figure 5. A "turn" of firewood being carried from the forest on the shoulder of a fuelwood cutter.

Figure 6. A pick-up truck load of firewood ready for transport to a fuelwood cutter's home.

The cord measure was converted to stacked cubic metres for presentation in the body of this report (1 cord = 3.62456 m^3 stacked). In the appendices data are presented in cord measure.

3.4 Data Analysis Methods

3.4.1 Average Volume Consumed per Wood Burning Household

Analysis of variance was carried out on the collected data to determine if there were significant differences at the 5% level in the volume burned per household between sampled towns within the management unit. Appendix 6 shows Unit 16 as an example of the analysis procedure. Summaries of analysis of variance for all units can be found in Appendix 7.

3.4.2 Number of Serious Wood Burners

The 1976 Statistics Canada census data was used to derive the number of households within each town and division within the management units. The number of households within each incorporated town was taken directly from the 1976 census. The only data available for the unincorporated town was the population size. This was divided by the family size in that area (as obtained from Statistics Canada) to approximate the number of households. Appendix 4 summarizes the number of households per town within the divisions of the management units.

The proportion of serious wood burners within each division in 1977-78 was calculated by dividing the number of serious wood burners by the total number of households sampled. These proportions were extrapolated to the total population of the division. The division estimates were totalled to give an estimate of the total number of wood burners in each management unit (Appendix 8). This same procedure was used to determine the number of serious wood burners for the island in 1978-79.

3.4.3 Proportion of Hardwood and Softwood Consumed

In each interview the respondent stated the volume of hardwood and softwood burned. For the purposes of this study softwood was defined as coniferous species and hardwood as deciduous species. An estimate of the percentage of softwood burned per unit was found by the following formula:

$$\frac{\text{Total volume softwood burned by respondents/unit}}{\text{Total volume roundwood burned by respondents/unit}} \times 100$$

3.4.4 Ancillary Data

Data were collected in each interview which indicated the rationale and history for wood burning by the respondents. This information was not extrapolated to the entire population as a whole but is presented exactly as collected in Appendix 9.

3.5 Results

Note: All data are reported for the fiscal year (April 1 to March 31).

3.5.1 Numbers of Households Seriously Burning Wood

The total number of wood burning households estimated for the island was 32,358 in 1977-78 and 39,498 in 1978-79. This represents a 22 percent increase for 1 year. These estimates exclude the households of St. John's and surrounding areas (Unit 1, Division 1), Fogo Island (Unit 5, Division 6), the Port aux Basaues area (Unit 14, Division 6), the households betwen Fox Roost and Burgeo (Unit 14, Division 7) and Gros Morne Park. Figure 7 shows the percentage and numbers of serious wood burning households within each forest management unit for 1977-78. Division 1 in Unit 1 was not included in these estimates because the sample size for the area was considered too small to give reliable estimates. Division 6 in Unit 14 was excluded because it was not sampled intensively. Division 7 in Unit 14, Division 6 in Unit 5 and Gros Morne Park were not sampled because of time constraints. Table 2 lists the unit data for the years 1977-78 and 1978-79. Appendix 8 provides a breakdown of the results by division and management unit.

3.5.2 Average Volumes Consumed per Serious Wood Burning Household

Figure 8 shows the average volume of fuelwood consumed per household in each management unit. The average volume consumed for the island was 14.25 m^3 stacked, per year (3.9 cords). Table 3 lists the average volume consumption data for each forest management unit.

The volume of fuelwood consumed for each household interviewed is listed in Appendix 10. This data displayed a Poisson distribution so it was transformed to display a Normal distribution before any analysis was performed. The formula used to transform the data was $Y = \sqrt{X + 0.5}$ where X = volume reported by householder and Y = transformed volume.

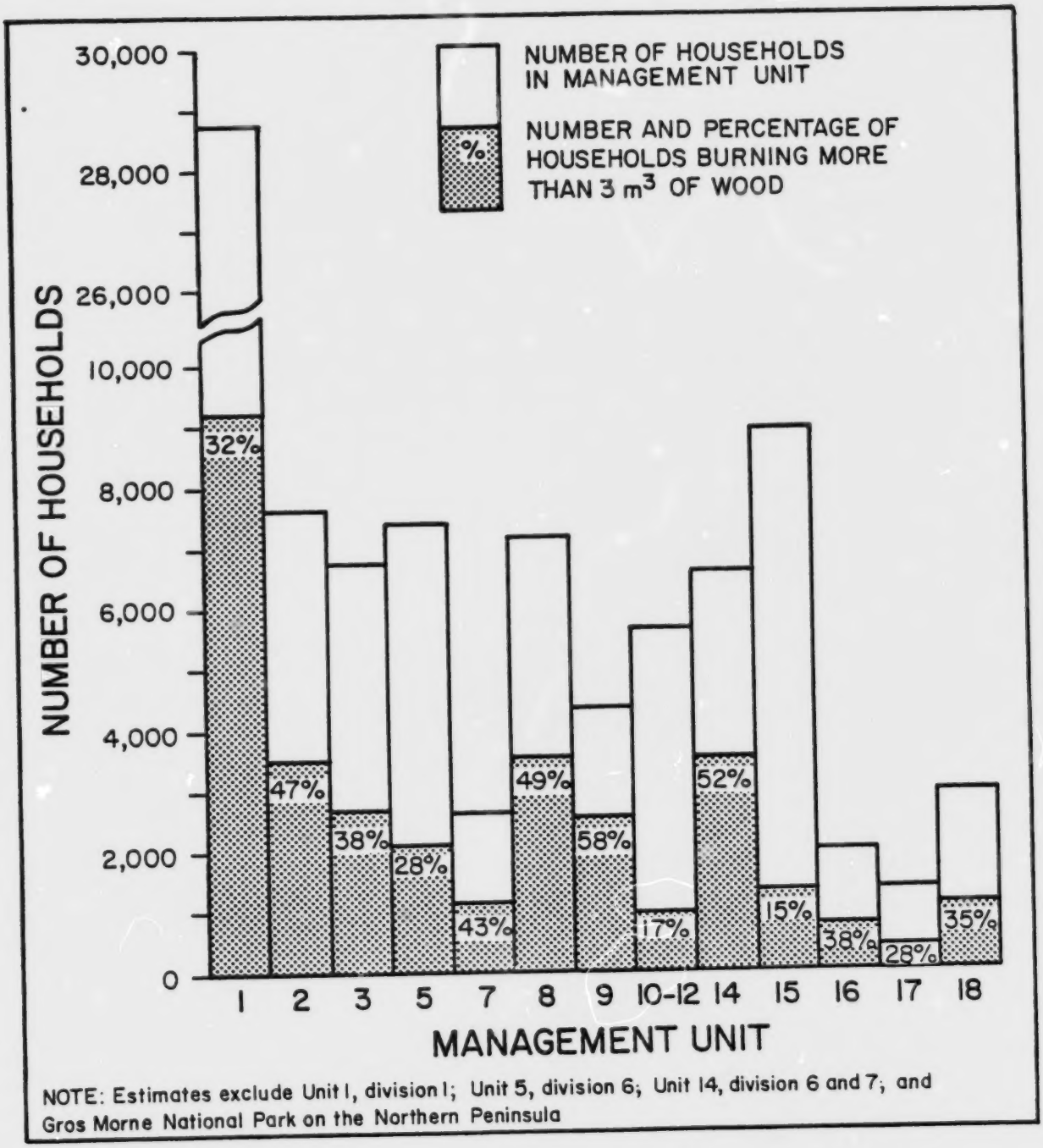

Figure 7. Distribution of serious wood burning households for 1977-78.

Table 2. Estimated number of fuelwood burning households by forest management unit and for the island of Newfoundland for the years 1977-78 and 1978-79.

Unit	Number of households	Estimated total number of serious wood burners 1977-78	1978-79
1[a]	28,721	9,200	11,582
2	7,662	3,605	4,258
3	6,738	2,543	3,002
5[b]	7,378	2,093	2,896
7	2,572	1,117	1,214
8	7,169	3,491	4,032
9	4,325	2,491	2,842
10	5,618	933	1,271
14[c]	6,629	3,479	3,859
15	8,896	1,302	2,060
16	1,931	730	835
17	1,262	349	457
18	2,900	1,025	1,190
TOTAL	91,801	32,358	39,498

[a] excludes Division 1 (St. John's and surrounding area)

[b] excludes Division 6 (Fogo Island and area)

[c] excludes Division 6 and 7 (Port aux Basques area and the area between Fox Roost and Burgeo).

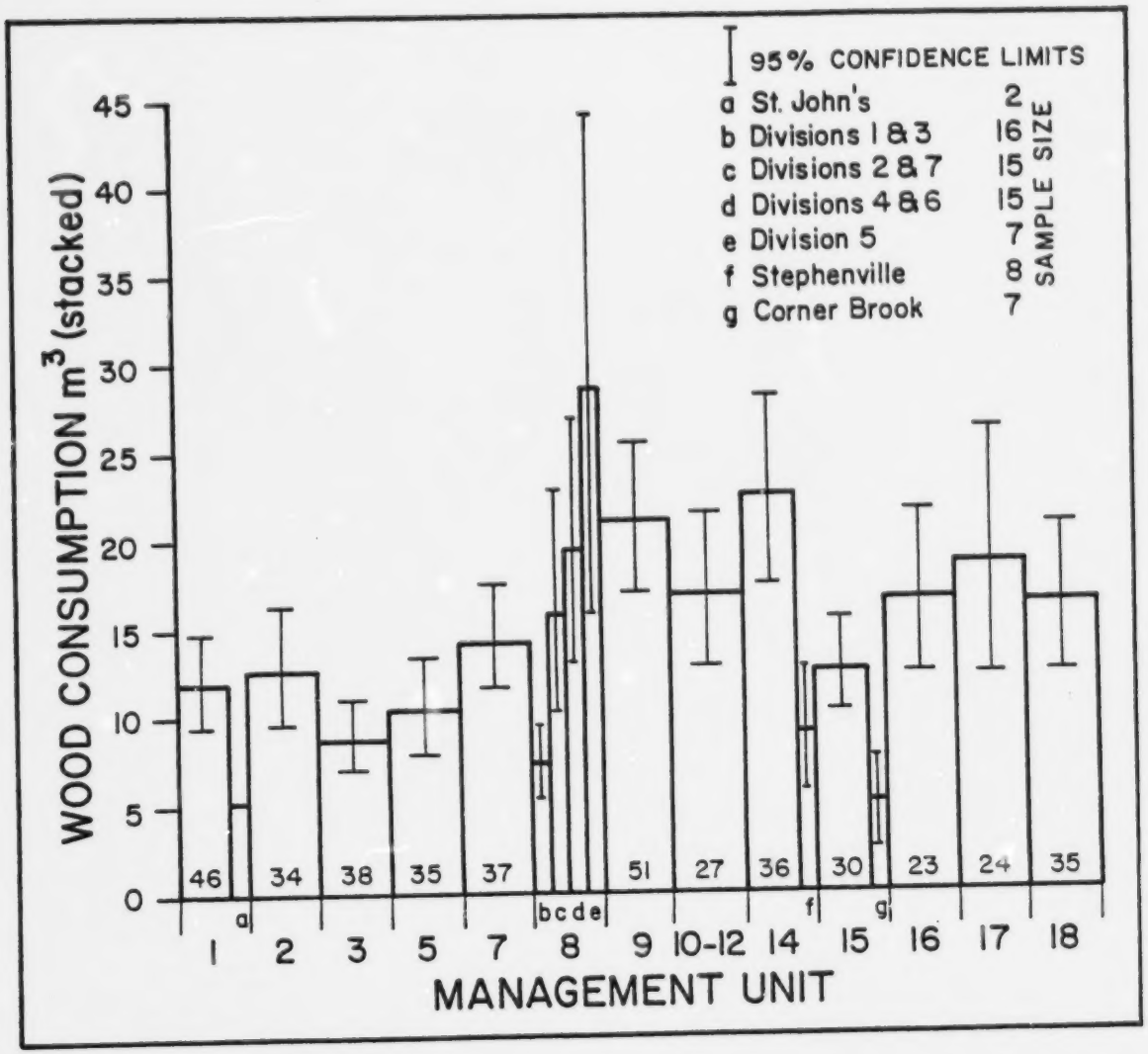

Figure 8. Average volume consumption of fuelwood per wood burning household by management unit in 1977-78.

Table 3. Average volume of wood burned in stacked cubic metres per serious wood burning household for 1977-78.

Unit	Mean	95% confidence limit upper	lower	Number sampled
1, excl. Div. 1	12.0	14.8	9.4	46
2	12.7	16.2	9.5	34
3	8.9	11.0	7.0	38
5, excl. Div. 6	10.5	13.3	7.9	35
7	14.2	17.5	11.7	37
8, Div. 1 + 3	7.3	9.4	5.3	16
Div. 2 + 7	15.9	22.9	10.2	15
Div. 4 + 6	19.3	26.8	13.1	15
Div. 5	28.5	44.4	15.9	7
9	21.0	25.4	17.0	51
10, 11, 12	16.9	21.4	12.8	27
14, excl. Div. 1, 6 & 7	22.5	28.1	17.5	36
Div. 1	9.0	12.8	5.8	8
15, excl. Div. 1	12.7	15.6	10.1	30
Div. 1	5.1	7.4	3.2	7
16	16.7	21.6	12.4	23
17	18.6	26.2	12.1	24
18	16.2	20.7	12.3	35

The analysis of variance showed that with the exception of Units 8, 14 and 15 there was no significant difference in the volume consumed per household between sampled towns within the management units at the 5% level. The overall mean volume was therefore applied to these units. In Unit 8 four distinct groups were found and means within each group were used separately. Removal of Stephenville from the Unit 14 data resulted in the volumes consumed in the remaining towns showing no significant difference at the 5% level. The mean for Stephenville was therefore calculated separately. The city of Corner Brook (in Unit 15) was also treated separately.

Management Units 9 and 14 (excluding Stephenville) showed the highest average volume consumption per household at 21.0 m^3 (stacked) and 22.5 m^3 respectively. Management Unit 3 showed the lowest average volume consumption per household at 8.9 m^3 (stacked). The low average volume consumption estimate for Unit 3 can probably be credited to the poor availability of wood in that unit.

3.5.3 Volume of Fuelwood Consumed

The estimate for the volume of fuelwood consumed on the island of Newfoundland for the year 1977-78 was 461 571 m^3 (stacked) or 127,345 cords. Figure 9 shows the volume of fuelwood consumed for each management unit for the year 1977-78. Unit 1 (Avalon Peninsula) had the highest total consumption of fuelwood at 110 400 stacked m^3 (30,459 cords), while Unit 17 has the lowest consumption at 6 491 stacked m^3 (1,791 cords).

Table 4 lists the summary of data utilized in determining the consumption volumes for the populated units and for the island as a whole. Appendix 8 provides the details of these data.

3.5.4 Proportion and Volume of Hardwood and Softwood Consumed

Figure 9 shows the estimated percentage of hardwood and softwood consumed in each forest management unit. These percentages were derived from the softwood and total wood listed in Appendix 10. Table 4 shows the total volume of fuelwood consumed, and the percentage and volume of softwood consumed in each management unit. Based on these data we estimated that 318 916 stacked m^3 (87,988 cords) of softwood were consumed on the island in 1977-78. The units in the eastern region (Units 1, 2, 3) generally show a high proportion of softwood being burned. The estimated total volume of hardwood consumed was 142 655 stacked m^3 or 39,358 cords. Unit numbers 10-12, 15 and 16 showed the highest proportion of hardwood consumption.

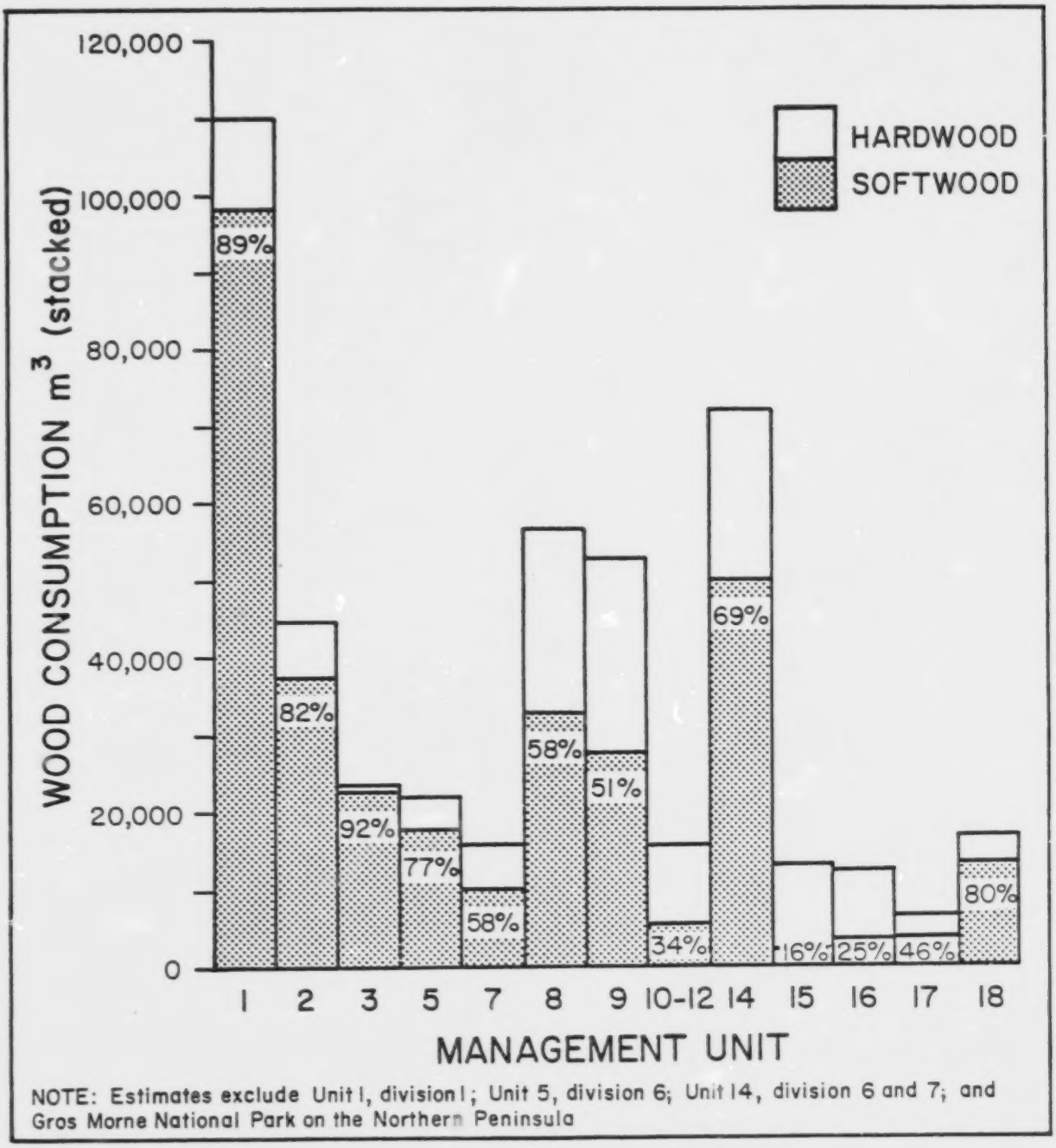

Figure 9. Consumption of hardwood and softwood firewood by management unit in 1977-78.

Table 4. Fuelwood consumption by management unit in 1977-78.

Management unit	Average consumption m^3 (stacked)	No. of serious wood burners 1977-78	Volume consumed m^3 (stacked)	Softwood %	Softwood vol.
1, excl. Div. 1	12.0	9,200	110 400	89	98,256
2	12.7	3,605	45 783	82	37,542
3	8.9	2,543	22 633	92	20,822
5, excl. Div. 6	10.5	2,093	21 977	77	16,922
7	14.2	1,117	15 861	58	9,199
8, Divs. 1 & 3	7.3	1,052	7 680	54	4,147
Divs. 2 & 7	15.9	527	8 379	32	2,681
Divs. 4 & 6	19.3	1,526	29 452	70	20,616
Div. 5	28.5	386	11 001	48	5,280
9	21.0	2,491	52 311	51	26,679
10, 11 & 12	16.9	933	15 768	34	5,361
14, excl. Div. 1, 6, 7	22.5	3,014	67 815	72	48,827
Div. 1	9.0	465	4 185	27	1,130
15, excl. Div. 1	12.7	842	10 693	18	1,925
Div. 1	5.1	460	2 346	9	211
16	16.7	730	12 191	25	3,048
17	18.6	349	6 491	46	2,986
18	16.2	1,025	16 605	80	13,284
TOTAL		32,358	461 571		318,916

The fuelwood volume consumption was recorded as either hardwood or softwood. However, an effort was made during each interview and during the interviewer's travels to note the various species utilized.

The three most common tree species used for firewood on the island of Newfoundland are black spruce (Picea mariana (Mill.) B.S.P.), balsam fir (Abies balsamea (L.) Mill.) and white birch (Betula papyrifera Marsh.). These are also the three most common tree species growing on the island. Other tree species were utilized to a minor extent. These were:

tamarack (Larix laricina (Du Roi) K. Koch.)
trembling aspen (Populus tremuloides Michx.)
yellow birch (Betula alleghaniensis Britt.)
speckled alder (Alnus rugosa (Du Roi) Spreng.)
mountain maple (Acer spicatum Lam.)
red maple (Acer rubrum L.)
eastern white pine (Pinus strobus L.)
white spruce (Picea glauca (Moench.) Voss.)
american mountain ash (Sorbus americana Marsh.)
showy mountain ash (Sorbus decora (Sarg.) Schneid.)
pin cherry (Prunus pensylvanica L.f.)
choke cherry (Prunus virginiana L.)

3.5.5 Trends in Fuelwood Use

The estimates for the number of householders burning wood in 1977-78 and 1978-79 were used in conjunction with information for the year the interviewed householders started burning wood (Table 5) and then extrapolated to the previous years to show the trend in increased wood burning appliance use. Figure 10 shows the trend in wood appliance use for the period 1973-79 for the 3 forestry regions in Newfoundland. It is evident from the graph that the major increase in fuelwood consumption started around 1975.

Ancillary data on woodfuel burning habits and appliances for the communities sampled in each forest management unit are listed in Appendix 9. These data are summarized by management unit in Table 5.

3.5.6 Relationship Between Households Using Woodfuel and the Price of Heating Oil and Electricity

Figure 11 shows the relationship between the increase in number of householders burning wood and the cost of oil and electricity. It is clearly evident from this graph that as the price of oil

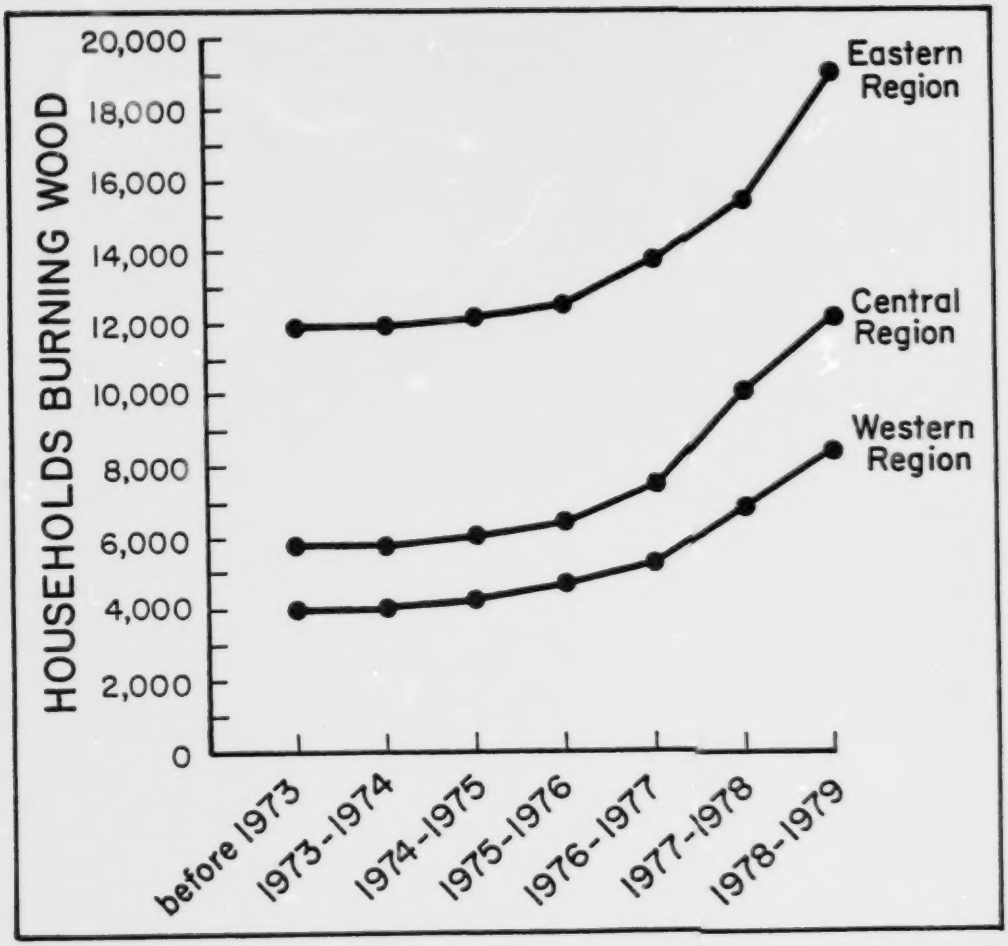

Figure 10. Trends in wood burning appliance use in forestry management regions (1973-1979).

Table 5. Ancillary data of woodfuel burning habits and opinions.

Island Summary		Type of Woodburning Unit							Sources of Heat				Year Started Burning Wood						Reasons for Burning Wood		Employment (Head Hsld.)			Distance Travelled to Obtain Wood (One Way)					Expected Wood Consumption in 78-79 Compared to 77-78			
Management Unit	No. sampled	Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Price of alternative heating	Other	Seasonal	Full time	Not employed	Less than 8 kilometres	9-16 kilometres	17-32 kilometres	33 + kilometres	Bought (distance unknown)	More	Less	Same	Stop burning
1	(48)	5	6	31			6		3	12	21	12	38		1	1	3	5	30	18	20	11	17	24	8	11	1	4	2	1	45	
2	(34)	7	11	12	4	1	2		1	11	20	2	22	1		1	6	4	23	11	9	14	11	21	3	7		3	8	1	24	1
3	(38)	1	2	30	1	1	3			3	25	10	33					5	20	18	13	11	14	21	7	7		3	1		37	
5	(35)	7	8	14	1	4	5		1	4	30		25				1	9	21	14	11	15	9	17	8	7	2	1	6		29	
7	(37)	8	8	18		3	1	1	1	7	22	7	22	1		1	4	9	28	9	7	22	8	18	8	7	2	2	9		28	
8	(53)	14	18	17	2	3	4		6	16	28	3	35	2			6	10	39	14	30	14	9	23	4	8	14	4	10	2	41	
9	(51)	18	20	12	1	5		1	3	9	39		24		3	6	6	12	44	7	23	18	10	18	20	8	2	3	18	1	32	
10, 11, 12	(27)	2	16	7		2			1	6	17	3	8	2		1	2	14	25	2	9	12	6	9	11	3		4	7	3	16	1
14	(45)	6	18	18	1	2	1		4	11	27	3	29		4	3	3	6	33	12	18	15	12	24	3	4	9	5	11	4	30	
15	(37)	3	21	3	1	6	5		3	11	22	1	7	1	2	3	5	19	25	12	13	16	8	20	9	3	5		8		29	
16	(23)	4	13	3	1	1	1		2	4	17		12		1	1	2	7	18	5	10	9	4	16	4	3			6	1	16	
17	(24)	8	9	5			2			4	20		19				1	4	17	7	15	4	5	13	5	5	1		4		19	1
18	(35)	4	14	17	4			2	1		34		25			1	2	7	26	9	21	8	6	9	9	16	1		7		26	2
TOTAL	(487)	87	164	187	16	28	30	4	26	98	322	41	299	7	11	18	41	111	349	138	199	169	119	233	99	89	37	29	97	13	372	5

Note: Appendix 9 contains this same information broken down by towns sampled within management units.

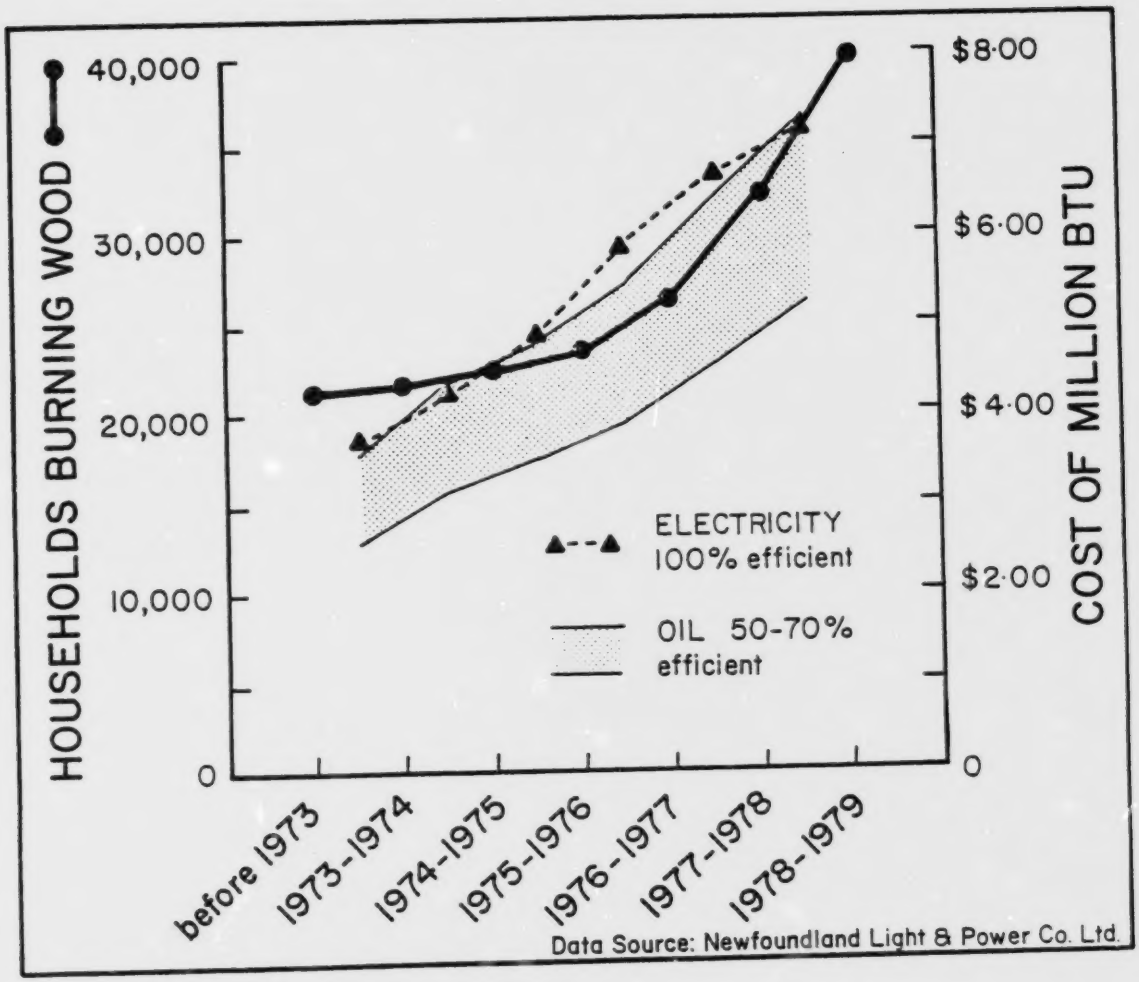

Figure 11. Relationship between the number of householders on the island burning wood and the cost of oil and electricity (1973-1979).

and electricity increased, so did the number of householders starting to use or reverting to wood heating in some fashion. It can also be seen from Table 5 (Reasons for Burning Wood) that most people indicated the price of alternative heating was the main reason for burning wood.

4.0 DISCUSSION

4.1 Available Data

Review of the published literature and contact with the forestry authorities in other areas showed that relatively little investigation of the volumes of firewood being consumed and their impact on the forest resource had been undertaken. This may be because management agencies were not prepared for the recent nationwide upsurge in demand for fuelwood brought about by rapidly increasing costs of heating oil and electricity. Whereas an increase in woodstove sales is readily apparent, and measurable, the increasing harvest of fuelwood is much more difficult to quantify. Most authorities recognized that an upswing in demand for fuelwood had occurred but appeared to lack methods to quantify the increased fuel consumption.

In the Newfoundland context, a detailed investigation into possible available data (i.e. cutting permit returns) identified mostly gaps and in a few cases, questionable statistics. The gaps were due to factors such as lack of government administrative staff in many regions until recently, the lack of a uniform policy for enforcing permit returns, and the existence of a very large amount of forest land (timber limits) to which the cutting permit regulations did not apply. In addition, in at least two management units firewood consumption estimates were made by disregarding the information on domestic permit returns and relying instead on on-the-spot checks by forestry representatives and consideration of the number of permits issued and returned. Most unit personnel readily admitted that the domestic cutting permit system presently in place was not providing accurate estimates of fuelwood consumption.

When it was discovered how few reliable fuelwood estimates were available it was decided jointly by the supervisory committee and NORTHLAND ASSOCIATES Ltd. to conduct household interviews in order to obtain data upon which to base estimates. It was also decided that any household consumption figures obtained for pre-1977 would probably be unreliable because they would be dependent on respondents' memories of long past events and efforts, and therefore subject to distortion. Therefore this study could not attempt to establish historical trends in the volume of wood consumed, but instead established trends in the number of new wood burning households.

4.2 Respondents' Attitudes

The respondents' attitude towards the survey was generally one of cooperation. Very few people refused to supply the information we were seeking. In some cases people found it difficult to estimate their consumption for various reasons. When an individual could not estimate his household's consumption, the next household on the list was interviewed in its stead.

Some people felt that the study was a basis for taxation and were reluctant to answer questions at first. When it was explained that this was not the case and any information collected would not be associated with the person giving it, people were cooperative. The respondents had no real reason to misrepresent their consumption since they could cut approximately 43 stacked m^3 (12 cords) without paying stumpage fees. Many of the persons interviewed boasted about how they cut oil and electricity consumption by using wood as a source of heat.

4.3 Volume of Fuelwood Consumed

The average volume consumed per wood burning household on the island was 14.25 stacked m^3 (3.9 cords). During the course of the work we were able to obtain four estimates of average annual household consumption from forestry personnel. These were 15.2, 17.4, 18.1 and 18.1 m^3 (stacked) per household and were somewhat higher than the average volume determined from the sample interviews. Except for Units 8, 14 and 15 we found no significant difference in the volume per household consumed within the units. In Unit 14, the only Diviion showing a significant difference was Stephenville. This may have been due to its urban nature since it had one of the lowest average consumption rates for the unit. Similarly, in Unit 15, the only Division showing a significant difference was the city of Corner Brook with the lowest per household consumption rate for the unit. The situation in Unit 8 is somewhat more complex and we could not readily identify reasons for the variability. Means for the divisions within the unit varied from 7.3 m^3 (stacked) for Divisions 1 and 3 to 28.5 m^3 (stacked) for Division 5.

The number of households burning wood compared with the total number of households in the management units was shown in Table 2. Unit 9 had the highest percentage of householders burning wood (52 percent) and Unit 15 had the lowest (17 percent). Unit 1 quite possibly had the lowest percentage of serious wood burning households but since Division 1 (St. John's and surrounding area) was not sampled intensively enough to provide valid estimates, it could not be included in the total unit estimate of the number of serious wood burning households.

As was expected, large urban centres had lower percentages of wood burners than did the smaller rural towns which have much easier access to wood supplies. The influence of these larger centres on the proportion of wood burning households can be seen in Figure 7. Units 5, 10-12, and 15 which contain Gander, Grand Falls-Windsor and Corner Brook respectively, show substantially lower proportions of serious wood burners than all the other units with the exception of Unit 17.

Table 6 compares the estimated volumes of firewood consumed based on Department of Forestry and Agriculture statistics and data found in the survey. The magnitude of the difference between the estimates is significant. It stems from the fact that the survey covered all lands in a unit whereas the permit returns cover only a portion of the lands in the management units.

Based on the discrepancy between these estimates and the general lack of confidence among resource managers in using permit returns to estimate domestic fuelwood consumption, we conclude that the permit system is a valid basis for making domestic fuelwood consumption estimates only if it is enforced throughout the unit, regardless of timber ownership.

4.4 Drain on Annual Allowable Cut

The consumption figures determined from the survey can be applied judiciously by forestry officials in order to determine the drain on the annual allowable cut (AAC). Table 7 lists the allowable annual cut for 1977-78 for the units sampled and the domestic fuelwood consumption volumes.

The total volume estimates reported from the survey cannot be taken absolutely as the annual drain by fuelwood harvesting on the productive forest stands in 1977-78. They refer mainly to roundwood but there could be an overestimate of roundwood consumption, especially in Unit 2. Any overestimate would be due to the availability and use of sawmill residue in the form of slabs. When contacting the households in the towns sampled, the first seven serious roundwood burners were interviewed. More phone calls were made to get an estimate of the percentage of serious wood burners in a given town. In some cases people reported burning a significant volume of slabs or old lumber but no roundwood. They were recorded as serious wood burners but no volume estimates were obtained from these households. However, in most cases people burning slabs were also burning a significant amount of roundwood (Figure 11). It is possible that because of the large number of sawmills in Unit 2 the roundwood

Table 6. Comparison of fuelwood cutting estimates for 1977-78 using permit returns and other means with interview sampling system.

Unit	Volume of firewood (stacked m^3) based on permit returns and other means[a]	Volume of firewood (stacked m^3) based on sampling by interviews
1	15 448	110 400
2	10 312	45 783
3	4 879	22 633
5	18 906	21 977
7	4 404	15 861
8	28 996	56 512
9	36 246	52 311
10-12	No estimate	15 768
14	36 064	72 000
15	1 004	13 039
16	6 107	12 191
17	1 812	6 491
18	3 494	16 605
TOTAL	167 672	461 571

[a]Dept. of For. & Agric., St. John's

Table 7. Comparison of annual allowable cut estimate with domestic fuelwood consumption in 1977-78.

Unit	Annual allowable cut[a] m^3 (stacked)	Domestic fuelwood consumption m^3 (stacked)	Domestic fuelwood consumption as a percentage of AAC
1	144 000	110 400	77
2	163 000	45 783	28
3	74 000	22 633	31
5	650 000	21 977	3
7	324 000	15 861	5
8	354 000	56 512	16
9	686 000	52 311	8
10-12	967 000	15 768	2
14	704 000	72 000	10
15	586 000	13 039	2
16	479 000	12 191	3
17	472 000	6 491	1
18	418 000	16 605	4
TOTALS	6 021 000	461 571	8

[a]AAC for hardwood and softwood converted from cunits to stacked m^3. The AAC data are only estimates (obtained from Dept. of For. & Agric.) based on the 1974 Global Inventory Figures. More reliable estimates will be available as the management unit inventories are completed.

volume estimate could be somewhat high. Part of the volume reported as round fuelwood could actually be sawmill waste. This factor would be less prevalent in other units.

The difficulty in determining whether the roundwood volumes reported were from scrub forest, logging residues, burned over areas, or good productive forests is another factor that could lead to an overestimate of the annual drain by fuelwood harvesting on the productive forest stands (Figures 13-16). The AAC estimates are made for productive areas only and do not include scrub forest containing less than 5 cunits per acre (approx. 21 m^3 (stacked)).

In Unit 18 a large portion of the firewood consumed in the Roddickton area came from pulpwood that was cut for Labrador Linerboard Ltd. and not used because of the closure of the mill in 1977. This is a temporary situation and when the pulpwood is consumed people will again be forced to cut their firewood from the forest.

In most other units people living in the vicinity of a logging operation obtained some residue in the form of tops and residual trees for firewood. In Units 10-12, a large portion of the volume reported was cut in burned over areas behind the Abitibi-Price Ltd. mill (Figure 13). This wood is relatively dry and light weight for handling. In Units 1 and 3, a large portion of the volumes reported may have come from scrub forest which predominates in many areas. In Unit 5, Division 2, there is a considerable harvest of wood from a burned-over area.

The consumption volume estimates of fuelwood determined in this study for 1977-78 can be used in present forest management planning if the previously mentioned factors are taken into consideration.

The recent rapid increase in demand for fuelwood requires monitoring and continued quantification. To use permit data for consumption estimates will require major changes in forest administration. Valid estimates of fuelwood consumption can be readily obtained by means of a sampling system as used in this study if a universal permit system is not adopted and enforced.

4.5 Type of Woodfuel

The proportion of softwood used within some of the management units appears high since hardwood (white birch) is usually preferred because of its higher heat output per unit volume. Units 1-5, 7-9, 14 and 18 used over 50 percent softwood in 1977-78. The availability of softwood over hardwood in these units was the main reason for the high rate of softwood utilization. Some people show a preference for

Figure 12. Firewood, slabs and roundwood.

Figure 13. Burned over area behind Abitibi-Price Ltd. Mill in Grand Falls used for firewood.

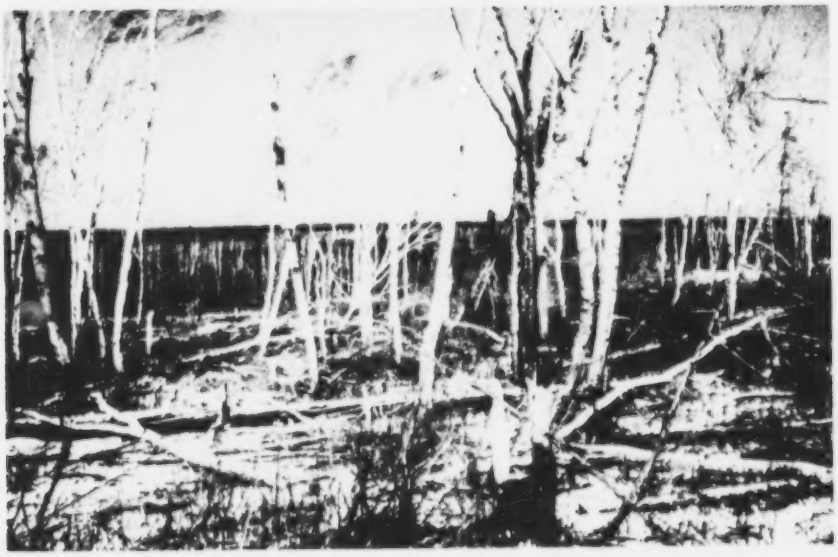

Figure 14.

Residual birch on cutover in central Newfoundland which is often used for firewood.

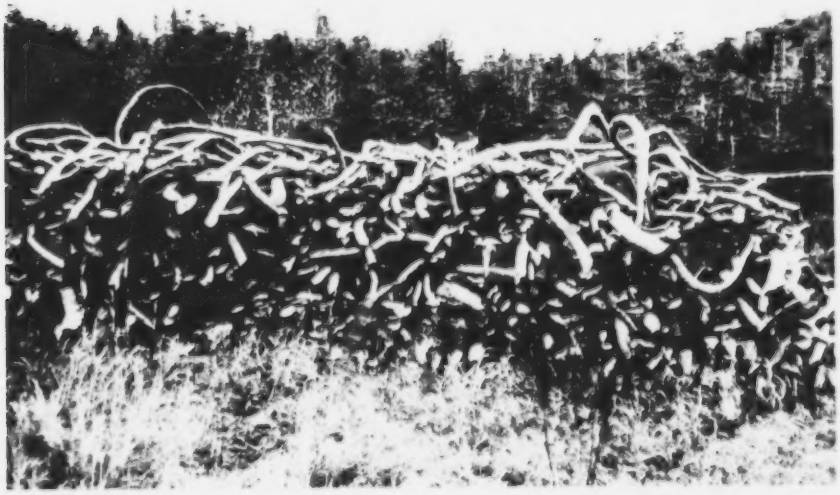

Figure 15.

Alder firewood.

Figure 16.

"Cranicks", small sticks of different species, sometimes used for firewood in Newfoundland.

softwood because it is lighter than hardwood and therefore easier to handle. There are large volumes of hardwood in some of the previously mentioned units but it is not near the populated areas. Generally speaking, a majority of the communities in Newfoundland are along or near the coastline, where the predominant species are softwoods. In Units 10-12, 15 and 16, the softwood consumption is well below 50 percent due mainly to the high availability and local preference for hardwood.

Firewood is often cut along access roads constructed by the provincial government. Since these roads were built for extracting sawlogs and pulpwood (softwood), firewood cutting was often limited to softwood species.

4.6 Expected Fuelwood Consumption in 1978-79 and the Future, Compared to 1977-78

Information was collected as ancillary data so as to determine if those people already burning fuelwood were planning to show more reliance on it for heating in 1978-79 (Table 5). There is a certain degree of flexibility in the amount of each type of heating used by the householders since 95 percent of those interviewed stated that they had other sources of heat. The expected fuelwood consumption in 1978-79 should not be interpreted as a reflection of the severity of the winter but as a measure of the intentions of the households to increase, decrease, stop burning, or rely to the same degree on wood for heating.

A larger portion (76 percent) of the householders interviewed stated that they would burn about the same amount, while 20 percent indicated that they were going to show more reliance on wood in 1978-79. Three percent indicated they were showing less reliance on wood and one percent indicated that they intended to stop burning firewood.

Examination of the trend in wood use for heat energy (Figure 10) shows a rapid increase since 1975. Figure 11 shows that the increased cost in heating oil and electricity parallels the upsurge in woodfuel use.

Table 5 shows that the larger portion (approximately 62 percent) of wood burners interviewed, burned wood before April 1, 1973. Between 1973 and 1976 approximately 7 percent of the sampled households started burning wood. In 1976-77 and 1977-78, 8 percent and 23 percent respectively started burning wood. These increases in themselves are not the only indicators of increased wood consumption. It has to be remembered that

36 percent of the total number of wood burning units found were wood and oil stoves. As previously mentioned some people with combination wood and oil stoves indicated that they burned more wood as the price of oil increased.

Table 5 also shows that the reasons for burning wood were broken down into two categories: price of alternative heating, and other. Price of alternative heating appears to be the major reason for the increased interest in wood. This was reported by 72 percent of those interviewed. The other 28 percent burned wood for various other reasons, such as tradition, and preference for the comfort of wood heat.

There was a subjective judgment made by the interviewer when people reported both reasons. The answer stressed most was recorded. It is the opinion of the interviewer that price of alternative heating was probably over-stressed by the respondents. Some householders using wood and oil combination stoves as their only source of heat indicated they burned wood because of the price of oil, while many others indicated that burning only oil in these units was not sufficient to heat a house on cold days in the winter. We feel that most people using only wood and combination oil stoves were forced to burn a certain amount of wood regardless of the price of oil, in order to achieve an adequate level of heating comfort.

Newfoundland and Labrador Hydro reported in March, 1979, that electricity rates are forecast to keep increasing until 1987 when electricity from the Gull Island Power Development in Labrador may be available to the island. It is also universally predicted by economists and petroleum supply companies that the cost of hydrocarbons will continue to increase in price at a higher rate than other commodities.

It can be expected, therefore, that there will continue to be a rapid and substantial increase in the demand for fuelwood. Fuelwood can be expected to account for an increasing share of the allowable cut from most forest management units and for increasing quantities of logging and sawmill residues.

4.7 Types of Wood Burning Units

There were 516 wood burning units found in the 487 wood burning households interviewed (Table 5), therefore indicating more than one burning unit in some households.

The most common type of unit was the combination wood and oil burning kitchen stove. Approximately 36 percent of the burning units were of this type and had generally been used in the households for many years. The next most popular wood burning appliance was the wood burning stove, which made up approximately 32 percent of the total units in the households sampled. These stoves basically were heaters that could not be used for cooking. Most of them were the new, efficient air-tight heater type. Wood burning stoves that could be used for heating and cooking constituted approximately 17 percent of the total. These were generally older model kitchen stoves that had been in the households for many years.

Wood burning furnaces and wood and oil burning furnaces represented 3 and 5 percent respectively of the total number of wood burning units in the households surveyed. These percentages were low due to the fact that wood and wood and oil combination furnaces require large additional investment ($500-$2,000) for householders who already had non-wood central heating systems. Householders having central heating systems usually bought less costly wood heaters. We found that in general, households with a wood or wood and oil combination furnace were new houses. It can be expected that these types of heating units will become more prevalent as more new homes are built.

Fireplaces constituted 6 percent of the total number of wood burning units. In some cases serious wood burners attempted to use fireplaces to supplement other heating units, while in other cases the use of the fireplace was for aesthetic purposes only. Fireplaces were sometimes the first step towards attempted supplementary heating with wood for many people. People would use a fireplace as a secondary heat source for a year or two, and then install a more efficient wood heating unit.

The "other" type stoves encountered constituted about 1 percent of the sample and were usually oil drums or similar structures converted to wood stoves.

4.8 Sources of Heat

Table 5 shows that wood was very rarely the sole source of heat for the households sampled. It was generally used as a supplement to oil and electricity or, oil and electricity were used as a supplement to wood. Wood alone was used by only about 5 percent of the householders interviewed. The other 95 percent used wood and oil, wood and electricity, or a combination of wood, electricity and oil for heating. This could represent any combination of

heating appliances. The most common heat sources were wood and oil which were used in approximately 67 percent of the households sampled. Wood and electric heating combinations represented about 20 percent of the sample, and wood, oil and electricity represented about 8 percent.

4.9 Employment Status of Wood Burners

Information was obtained on the employment status of wood burners to ascertain if a significant number of full-time workers burned firewood (Table 5). Many individuals involved in forestry and heating oil sales felt that only seasonal workers and the unemployed had time to cut firewood. The survey showed this assumption to be incorrect. Full-time workers constituted 35 percent of the wood burners contacted. Seasonal workers made up 41 percent and the unemployed about 24 percent. Seasonal workers were defined as people who usually worked for a few months of the year. Unemployed people were generally those on long-term social assistance or old age pensioners. The employment status of the head of the household was recorded for the purposes of this question.

4.10 Distance Travelled to Obtain Firewood

Information on the distance travelled to obtain firewood was collected to obtain some appreciation for the difficulties people had in obtaining firewood. Fuelwood was obtained by 48 percent of those interviewed within a radius of 8 km of their homes (Table 5). Twenty percent obtained fuelwood in a radius of 9-16 km, 18 percent obtained it in a radius of 17-32 km, and 8 percent indicated they travelled 33 or more km from their homes. This 8 percent didn't necessarily always have to travel that far to obtain firewood. Some people cut firewood near their summer cabins and carried it home, while other people cut firewood while working away from home. Ninety-four percent of those interviewed cut firewood themselves or had it cut free of charge by a friend.

The remaining 6 percent purchased wood and could not be conveniently classified by distance since the distance was not known. These 6 percent were usually pensioners, widows and people under doctors' care.

4.11 Wood, Fuel Oil and Electricity Comparisons

The volume of fuelwood consumed in Newfoundland was not converted to the equivalent volume of oil and electricity. The main reasons for this were that the amount of useable space heating energy

obtainable from a given volume of wood varies, depending on the wood burning unit design, type and condition of wood fuel, wood burning unit installation and the manner in which it is used. Global estimates of fuel oil and electricity equivalents based on this particular survey could be very misleading.

Schneider (Appendix 11) shows very effectively the variables to consider when converting wood volumes to fuel oil and electricity equivalents. He also shows how to compare wood to the other fuels when the variables are known.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Fuelwood demand is escalating rapidly. Indiscriminate fuelwood cutting can lead to damage in immature stands that should be reserved for sawlog and pulpwood production. Fuelwood requirements can often be met by harvesting less valuable softwood and hardwood stands. Every effort should be made to direct fuelwood cutters to less merchantable timber stands, to burned forest areas that can be salvaged and to areas that have been logged for other purposes but which still contain significant logging residues. This practice is already followed to a large degree in some management units. The industrial users of raw timber should have first call on merchantable wood, with domestic fuelwood cutting concentrating on non-merchantable wood, residuals and waste.

While softwood is the major type of fuelwood cut, there is relatively high use of hardwoods (primarily white birch) in Units 15, 16, and 10-12. We are concerned that a shortage of accessible hardwood may be experienced in these units in the future. It is recommended that separate evaluations be made of projected fuelwood harvesting levels and allowable cuts for both hardwoods and softwoods in these units, to help ensure that shortages (especially of hardwoods) do not occur in the future.

To date the construction of forest access roads has been aimed mainly at providing access to merchantable timber (softwood sawlogs and pulpwood). Domestic fuelwood cutters use these roads to gain access to standing timber resources and logging residues. It may be worth considering constructing some access roads to stands of non-merchantable timber and then to directing fuelwood cutters to these stands. This would have the benefit of clearing or thinning non-merchantable stands, while reducing overcutting that might be occurring on nearby merchantable stands. The practice and philosphy of constructing such roads should be

developed as part of the overall forest management plan and with due consideration for site factors.

Table 7 compared the annual allowable cut with the estimated fuelwood consumption. Factors such as the accuracy of the annual allowable cut estimate and the accuracy of the fuelwood consumption volumes with their attendant bias due to scrubwood and slabwood availability, etc., preclude concise conclusions. However, it is evident that in Units 1, 2, and 3 a significant portion of the annual allowable cut is being used for firewood and therefore, trends and volumes in fuelwood harvesting in these units should be closely monitored. In other units a biennial assessment of fuelwood consumption should be sufficient for management planning purposes until fuelwood consumption becomes a significant proportion of the annual allowable cut.

At present the best system to accomplish this monitoring is by means of a survey similar to this study. The permit system could also be used, provided there is an enforced domestic cutting permit system for all lands. In addition, a high rate of permit returns, showing accurate volume estimates, must be in operation. The volumetric reporting of permits should include a space for reporting "pick-up truck loads", as well as other measurements (e.g., cords). A pick-up load is the rough unit of measurement commonly used by many people in determining fuelwood volumes consumed.

Since fuelwood consumption is expected to increase considerably in the foreseeable future, a close monitoring of the effect this demand will have on the forest resource, is an important consideration in the formulation of management plans.

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Dalton, M.M., J.H. Harrington, O.B. Durgin and R.A. Andrews. 1977. Household fuelwood use and procurement in New Hampshire. New Hampshire For. Exp. Sta. Res. Rep. No. 59.

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APPENDIX 1

STATEMENT OF WORK ORIGINALLY CONTRACTED FOR BY NORTHLAND ASSOCIATES LTD.

The work will be carried out by a consultant under contract with the Department of Supply and Services. Project supervision will be provided by the Newfoundland Forest Research Centre. The study will be carried out in four main phases as outlined below.

Phase I - Literature Review and Assessment of Existing Data Sources

This will involve a literature review and evaluation of all existing data sources on fuelwood consumption on the island of Newfoundland. The main sources are outlined below.

Newfoundland Forest Service - Historical statistics in the form of cutting permit returns are available for some areas of non-alienated Crown lands that have been designated as forest management areas. (These areas comprise only part of the non-alienated Crown forest land on the Island). These statistics are kept at approximately 12 district forestry offices and these would have to be visited during this phase of the study. Preliminary estimate is for one month's field work for this aspect of the study.

Statistics Canada - Some data on household heating facilities in use in Newfoundland are available from this source. Also information on consumption and prices of alternative fuels will have to be collected as background information for the evaluation of trends in fuelwood consumption.

Other Agencies - It is expected that relevant information will have to be collected from agencies such as the Ministry of Transport (climatic data), Newfoundland Hydro and various other organizations.

Data from all available sources will be evaluated. Gaps in the data base will be identified in a brief progress report to the supervisory committee with recommendations on procedures to be followed in Phase II.

Phase II - Obtaining Supplementary Data

In cooperation with the supervisory committee the consultant will prepare a plan to obtain data on current fuelwood consumption so that an overall estimate of fuelwood harvesting for all forest lands (alienated and non-alienated Crown lands) can be prepared. This may involve the design and circulation of a questionnaire to selected individuals in some

management units to verify estimates of per capita consumption of fuelwood. Some scaling of wood harvested for fuel may be required.

Travel to a number of Management Units in each region will also likely be required during this phase. Preliminary estimate is for one month of field work for this phase of the study.

Phase III - Analysis of Data

Data collected in phases I and II will be analysed to provide the following information:

(1) Estimate of fuelwood consumed in 1977 and estimates of past 5-year trend in fuelwood consumption by forest districts, forest regions and for the island as a whole. Kind of wood consumed (i.e. hardwood, and softwood, roundwood and mill residues) will be indicated to the extent possible.

(2) Trends in the rate of substitution of wood for oil and electricity at alternative price levels for these competing fuels. Possible effects of increases in the price of alternative fuels on the future demand for fuelwood.

(3) Projection of fuelwood consumption for the next five years by forest district, region and for the Island.

Phase IV - Preparation of Report

The findings of the study will be summarized in a report prepared by the consultant under the general guidance of the scientific authority. Twenty-five copies will be required. The consultant will be required to summarize the findings of the study at a one-day meeting in Ottawa in December 1978 (Travel costs incurred will be at the consultant's expense).

The report will include recommendations for a procedure for more accurate estimation and forecasting of fuelwood requirements on the Island.

APPENDIX 2

Addresses for Contacts Made During Phase I of the Survey

NEWFOUNDLAND

Provincial Government Forestry Offices (Visited)

Eastern Region Headquarters
Building T-851
Pleasantville, St. John's

Management Unit 1
P.O. Box 220
Foxtrap

Management Units 2 & 3
P.O. Box 209
Clarenville

Central Region Headquarters
8 Roe Avenue
Gander

Management Units 4 & 5
Gambo

Management Units 6 & 8
P.O. Box 217
Lewisporte

Management Unit 7
Milltown, Bay D'Espoir

Management Unit 9
P.O. Box 220
Springdale

Management Unit 10
Kinsmen Drive
Bishops Falls

Western Region Headquarters
Corner Brook

Management Unit 14
P.O. Box 279
St. George's

Management Unit 15
Massey Drive
Corner Brook

Management Unit 16
P.O. Box 340
Pynn's Brook

Management Unit 17
Port Saunders

Management Unit 18
Roddickton

Other Provincial Government Agencies (Visited)

Dept. of Mines & Energy
Eastern Canada Building
St. John's

Central Statistical Services
Executive Council
Confederation Bldg., St. John's

Federal Agencies (Visited)

User Advisory Services
Statistics Canada
Crosbie Road
St. John's

Atmospheric Environment Services
Environment Canada
Pleasantville
St. John's

Pulp and Paper Companies (Visited)

Bowater Nfld. Ltd.
Corner Brook

Abitibi Price Ltd.
Grand Falls

Wood Stove Dealers and Agents (Visited)

Kerr Controls Ltd.
9½ Mullock Street
St. John's

Quality Woodstoves Ltd.
1 Pilot's Hill
St. John's

Levitz Agencies Ltd.
Hub Building
Rawlins Cross
P.O. Box 1270
St. John's

Fuel Oil Companies (Visited)

Golden Eagle Canada Limited
93 Elizabeth Avenue
St. John's

Gulf Canada Limited
Southside Office
St. John's

Hydro

(Visited)

Nfld. Light & Power Co. Ltd.
Kenmount Road
St. John's

(Contacted)

Nfld. & Labrador Hydro
Elizabeth Towers
St. John's

CANADA

Federal Agencies (Contacted)

Data Base Services
Fisheries and Environment Canada
Ottawa, Ontario

Special Surveys Coordination Division
Statistics Canada
9th Floor, Jeanne Mance Building
Ottawa, Ontario
K1A 0T6

Provinces (Contacted)

Mr. Donald M. Wright
Supervisor, Production Surveys
Department of Lands & Forests
Truro, Nova Scotia
B2N 5B8

Mr. Andrew Wells
The Institute of Man and Resources
50 Water Street
P.O. Box 2008
Charlottetown, PEI C1A 1A4

Mr. Marc Schneider
Associate Professor, Wood
Science and Technology
Dept. of Forest Resources
University of New Brunswick
P.O. Box 4400
Fredericton, New Brunswick
E3B 5A3

Ms. Ann Dutchburn
Executive Secretary
Canadian Wood Energy Institute
49 Gloucester Street
Toronto, Ontario
M4Y 1L8

United States (Contacted)

Dr. James E. Shottafer
Head, Forest Products Laboratory
University of Maine at Orono
Nutting Hall
Orono, Maine 04473

Mr. Rod Sando, Director
Division of Forestry
Department of Natural Resources
St. Paul, Minnesota
55155

Mr. Ted Cady, Forester
R.C. & D. Office
Dept. of Environmental Management
P.O. Box 408
Sunderland, Massachusetts
01375

Mr. Guy W. Rodgers
Supervisor, Private Forestry
Department of Natural Resources
Box 7921
Madison, Wisconsin
53707

Mr. Jack A. Zollner
Forest Products Utilization
and Marketing Specialist
Department of Natural Resources
P.O. Box 30028
Lansing, Michigan 48909

Mr. O. Lynn Frank, Chief
Timber Management Section
Department of Environmental Resources
P.O. Box 1467
Harrisburg, Pennsylvania 17120

Mr. Daniel W. Weller
Principal Forester, Bureau of
Forest Resource Management
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York 12233

Agricultural Experiment Station
Taylor Hall
University of New Hampshire
Durham, New Hampshire 03824

APPENDIX 3

Management Unit _____

Date _____

Community _____

Approx. location in unit _____

1. What type of wood burning unit do you have?

   a) Wood stove (heating and cooking) _____
   b) Wood stove (heating) _____
   c) Wood and oil stove _____
   d) Wood furnace _____
   e) Wood and oil furnace _____
   f) Fireplace _____
   g) Other (specify) _____

2. What were your sources of heat in 1977-78?

   a) Wood only _____
   b) Wood and electricity _____
   c) Wood and oil _____
   d) Wood, electricity, and oil _____

3. When did you start burning wood?

   a) Always (before March 31, 1973) _____
   b) 197_____

4. Why do you use wood rather than other sources of heat?

   a) Price of alternative heating _____
   b) Other (specify) _____

5. Employment (head of household)

   a) Seasonal _____
   b) Full time _____
   c) Not employed _____

6. How much wood did you burn from April, 1977 - April, 1978 and in what form was it?

Form		Volume
a)	Sawmill residue _____	_____
b)	Hardwood roundwood _____	_____
c)	Softwood roundwood _____	_____
d)	Other (specify) _____	_____

7. About how far do you go to get wood (approx.)?

   a) ≥ 5 miles _____
   6-10 _____
   c) 11-20 _____
   d) 21+ _____

8. How will this year's wood consumption compare with last year's?

   a) More _____
   b) Less _____
   c) Same _____
   d) Do you, or will you, take out your wood burning unit in the 1978-79 fiscal year?

      Yes _____

APPENDIX 4

LIST OF COMMUNITIES AND DIVISION IN FOREST MANAGEMENT UNITS AND THEIR RESPECTIVE NUMBER OF HOUSEHOLDS AND INCORPORATIONAL STATUS

UNIT 1

DIVISION 1

Goulds	I	740	Paradise	I	515
Hogans Pond	I	30	*St. John's	I	22,840
Mount Pearl	I	2,660	Wedgewood Park	I	315
			TOTAL		27,100

DIVISION 2

Admirals Beach	I	75	Ferryland	I	170
Admiral's Cove	U	28	Flatrock	I	165
Angels Cove	U	11	Forest Field	U	11
Aquaforte	I	50	Fox Harbour	I	120
Argentia	U	17	Freshwater	I	295
Arnold's Cove	I	295	Gaskiers/Pt.La Haye	I	120
Bauline	U	42	Great Barasway	U	9
Bauline East	U	19	Green's Harbour	U	181
Bay Bulls	U	283	Harricott	U	18
Bellevue	U	89	Heart's Delight/		
Blaketown	U	138	Islington	I	210
Branch	U	110	Heart's Desire	U	75
Brigus South	U	19	Hopeall	U	64
Broad Cove	U	27	*JERSEYSIDE	I	215
Burnt Cove	U	34	La Manche	U	2
Calvert	U	112	Little Barasway	U	4
Cape Broyle	U	182	Little Harbour	U	100
Cape St. Marys	U	3	Long Harbour/		
Cappahayden/Renews	I	145	Mount Arlington Hts.	I	140
Cavendish	U	87	Mall Bay	U	19
Chance Cove	I	105	Markland	U	87
Chapel Arm	I	150	Mobile	U	33
Colinet	I	55	Mount Carmel/		
Crockers Cove	U	13	Mitchell's Brook/		
Cuslett	U	27	St. Catharine's	I	145
*DILDO	U	220	New Bridge	U	17
Dildo South	U	71	New Harbour	U	200
Dunville	I	450	Norman's Cove/		
Fair Haven	U	39	Long Cove	I	255
Fermeuse	I	115	North Harbour	U	38

I = Incorporated communities; No. of households Stats. Can., 1976
U = Unincorporated communities; Population

Family size

* Community sampled.

DIVISION 2 (cont.)

O'Donnells	U	71	St. Michaels	U	16
Old Shop	U	55	St. Stephens	U	40
Path End	U	18	St. Vincent's	U	155
Patrick's Cove	U	42	Ship Cove	U	7
Peter's River	U	22	Ship Harbour	U	65
Petty Harbour/			Shoe Cove	U	78
Maddox Cove	I	205	Shore's Cove	U	10
Placentia	I	500	Southern Harbour	I	140
Point Lance	I	25	Thornlea	U	49
Point Verde	U	71	Torbay	I	695
Port Kirwin	I	35	*TORS COVE	U	90
Portugal Cove	U	392	Whitbourne	I	305
Pouch Cove	I	375	Whiteway	I	55
Riverhead	I	80	Witless Bay	U	228
St. Bride's	I	125			
St. John's Area	U	4,700	TOTAL		14,538
*ST. JOSEPH'S	U	70			
St. Mary's	I	110			

DIVISION 3

Avondale	I	200	Gullies	U	27
Bareneed	U	43	Halls Town	U	77
Birch Hills	U	22	Harbour Main	U	254
Black Duck Pond	U	29	Hibbs Cove	U	46
Blow me Down	U	37	Holyrood	I	365
Brigus	I	215	Indian Pond	U	25
Brigus Gullies	U	9	Kelligrews	U	96
Brigus Junction	U	21	Lawrence Pond	U	3
Butlerville	U	86	Mackinsons	U	106
*CHAPEL COVE	U	79	Mahers	U	5
Clarke's Beach	I	240	Marysvale	U	180
Colliers	I	170	North River	I	220
Conception Bay South	I	2,335	Peachtown	I	115
Conception Harbour	I	205	Port de Grave	U	66
Cupids	I	195	Roaches Line	U	35
Cupids Crossing	U	16	*SEAL COVE	U	112
Foxtrap	U	145	Shearstown	U	73
Georgetown	U	85	Ship Cove	U	64
Goulds Road	U	49	South River	I	165
Greeleytown	U	145	Woodford's	U	1
			TOTAL		6,361

DIVISION 4

Bay de Verde	I	195	New Melbourne	U	28
Bay Roberts	I	1,110	New Perlican	I	100
Bears Cove	U	8	Northern Bay	U	59
Biscay Bay	U	23	Ochre Pit Cove	U	28
Bishop's Cove	I	85	Old Perlican	I	185
Bristol's Hope	U	28	Perry's Cove	U	38
Brownsdale	U	46	Portugal Cove South	U	70
Bryants Cove	U	91	Red Head Cove	U	58
*BURNT POINT	U	60	Riverhead	U	104
Caplin Cove	U	43	St. Shott's	I	45
Carbonear	I	1,210	Salmon Cove	I	180
Carbonear Suburbs	U	27	Sibleys Cove	U	44
Flatrock	U	29	Small Point/		
Freshwater	U	62	Broad Cove/		
Grates Cove	U	64	Blackhead/		
Gull Island	U	98	Adams Cove	I	190
Hant's Harbour	I	145	Smooth Cove	U	14
Harbour Grace	I	765	Spaniards Bay	I	415
Harbour Grace South	I	95	The Thicket	U	18
Hearts Content	I	155	Tilton	U	125
Job's Cove	U	47	Trepassey	I	310
Kingston	U	36	Turks Cove	U	14
Lead Cove	U	22	Upper Island Cove	I	435
Long Beach	U	27	Victoria	I	395
Lower Island Cove	U	98	Western Bay	U	114
Low Point	U	12	Winterton	I	225
Mizzen Cove	U	6			
New Chelsea	U	41	TOTAL		7,822

UNIT 2

*DIVISION 1

Clarenville	I	740	Shoal Harbour	I	260
			TOTAL		1,000

DIVISION 2

*BONAVISTA	I	1,155
TOTAL		1,155

DIVISION 3

Adeyton	U	16
Amherst Cove	U	16
Aspen Cove	U	10
Aspey Brook	U	12
Birchy Cove	U	12
Bloomfield	U	169
Britannia	U	30
Brooklyn	U	46
Bunyan's Cove	U	133
Burgoynes Cove	U	19
Cannings Cove	U	91
Caplin Cove	U	28
Catalina	I	275
Champney's	U	20
Champney's West	U	37
Charleston	U	42
Charlottetown	U	86
Clifton	U	15
Come-by-Chance	U	80
Davis Cove	U	8
Deep Bight	U	52
Dunfield	U	52
Duntara	I	30
Elliott's Cove	U	25
Elliston	I	170
*ENGLISH HARBOUR	U	24
Ganny Cove	U	23
Garden Cove	U	39
Georges Brook	U	88
Goobies	U	43
Gooseberry Cove	U	42
*GOOSE COVE	U	39
Harcourt	U	63
Hatchet Cove	U	28
Hickman's Harbour	U	115
Hillview	U	88
Hodge's Cove	I	95
Ivany Cove	U	10
Jamestown	U	39
Keels	I	35
King's Cove	I	65
Knights Cove	U	27
Lady Cove	U	36
Lethbridge	U	184
Little Catalina	I	175
Little Harbour	U	18
Little Heart's Ease	U	117
Lockston	U	13
*LONG BEACH	U	34
Lower Lance Cove	U	50
Melrose	I	75
Middle Amherst Cove	U	14
Milton	U	64
Monroe	U	14
*MUSGRAVETOWN	I	170
New Bonaventure	U	27
New Burnt Cove	U	31
Newmans Cove	U	58
North Harbour	U	57
North West Brook	U	78
Old Bonaventure	U	24
Open Hall	U	23
Petley	U	40
Plate Cove East	I	45
Plate Cove West	I	50
Port Blandford	I	200
Portland	U	27
Port Rexton	U	140
Port Union	I	180
Princeton	U	51
Queen's Cove	U	37
Red Cliff	U	16
Snooks Harbour	U	18
Southern Bay	U	40
Southport	U	52
Spillars Cove	U	33
Stock Cove	U	18
St. Brendan's	I	95
St. Jones Within	U	34
Summerside	I	195
Sunnyside	I	185
Sweet Bay	U	55
Swift Current	U	97
Terra Nova	I	25
Tickle Cove	U	21
Trinity/Goose Cove	I	100
Trinity East	U	42
Trouty	U	28
Upper Amherst Cove	U	16
Waterville	U	11

DIVISION 3 (cont.)

Weybridge	U	32	Winter Brook	U	25
				TOTAL	5,507

UNIT 3

DIVISION 1

English Harbour East	I	60	*TERRENCEVILLE	I	145
Grand Le Pierre	I	70			
				TOTAL	275

DIVISION 2

Baine Harbour	I	60	L'Anse-au-Loup	I	100
Bay L'Argent	I	115	Little Bay East	U	50
Boat Harbour	U	45	Little Harbour East	U	11
Brookside	U	19	Molliers	U	3
Burnt Islands	I	170	Monkstown	U	27
Frenchman's Cove	I	80	Parkers Cove	I	75
Garnish	I	200	Petit Forte	U	19
Grand Beach	U	22	*RED HARBOUR	I	60
Harbour Mille	U	73	Rushoon	I	105
Jacques Fontaine	U	45	St. Bernard's	I	115
			South East Bight	U	20
				TOTAL	1,414

DIVISION 3

Jean de Baie	U	31	Spanish Room	U	33
*MARYSTOWN	I	1,295	Winterland	I	50
Rock Harbour	U	33			
				TOTAL	1,442

DIVISION 4

Beau Bois	U	16	Fox Cove/Mortier	I	110
*BURIN	I	600	Lewins Cove	I	110
Corbin	U	8	Port au Bras	I	90
Epworth	U	52	Salmonier	U	12
				TOTAL	998

DIVISION 5

Lamaline	I	140	Point au Gaul	I	30
Lawn	I	190	Point May	I	75
Little St. Lawrence	U	57	St. Lawrence	I	470
*LORD'S COVE	I	75	Taylor's Bay	U	7
				TOTAL	1,044

DIVISION 6

Fortune	I	565	*GRAND BANK	I	1,000
				TOTAL	1,565

UNIT 4

No population

UNIT 5

DIVISION 1

*ASPEN COVE	U	58	*LADLE COVE	U	52
Carmanville	I	245	Main Point	U	44
Fredericton	U	90	Mann Point	U	69
Gander Bay South	U	75	Noggin Cove	U	76
Harris Point	U	27		TOTAL	736

NB: Aspen Cove and Ladle Cove inseparable in telephone book.

DIVISION 2

*BADGER'S QUAY (162)/ Valleyfield/			Lumsden	I	150
			Musgrave Harbour	I	370
Pool's Island	I	320	Newtown	I	125
Cape Freels	U	24	Parson's Point	U	49
Deadman's Bay	U	50	Wesleyville	I	300
Greenspond	I	165			
				TOTAL	1,553

DIVISION 3

Benton	I	55	Hare Bay	I	335
Centreville	I	135	Indian Bay	I	40
Dover	I	180	Trinity	I	125
*DARK COVE/MIDDLE BROOK/GAMBO	I	630	Wareham	I	90
				TOTAL	1,590

DIVISION 4

*GANDER	I	2,350
TOTAL		2,350

DIVISION 5

Burnside	U	35	St. Chads	U	25
Cull's Harbour	U	24	Salvage	I	65
*EASTPORT	I	140	Sandringham	I	55
Glovertown	I	555	Sandy Cove	I	50
Happy Adventure	I	105	Traytown	I	95
			TOTAL		1,149

DIVISION 6 - NOT SAMPLED

Barr'd Islands/ Joe Batts Arm	I	240	Island Harbour	U	66
Change Islands	I	145	Seldom/ Little Seldom	I	115
Deep Bay	U	34	Shoal Bay	U	14
Fogo	I	245	Stag Harbour	U	66
			Tilting	I	95
			TOTAL		1,020

UNIT 6

No population

UNIT 7

DIVISION 1

Head of Bay D'Espoir	U	122	St. Joseph's Cove	U	34
*ST. ALBANS	I	400	St. Veronica's	U	29
			TOTAL		585

DIVISION 2

Conne River	I	80	Morrisville	I	40
*MILLTOWN	U	163	TOTAL		283

DIVISION 3

Francois	U	48	McCallum	U	53
Gaultois	U	105	*POOL'S COVE	I	65
*HERMITAGE/Dawson's Cove	U	180	Seal Cove	I	120
			TOTAL		571

DIVISION 4

Belleoram	U	115	*HARBOUR BERTON	I	445
Boxey	U	19	Mose Ambrose	U	19
English Harbour West	U	75	Rencontre East	I	45
			St. Jacques/Coombs Cove	I	415
				TOTAL	1,133

UNIT 8

DIVISION 1

*BOTWOOD	I	1,080	Lewisporte	I	920
				TOTAL	2,000

DIVISION 2

Cottrell's Cove	U	88	Northern Arm	I	55
Fortune Harbour	U	35	Paradise	U	22
Glovers Harbour	U	29	Phillips Head	U	48
Leading Tickles West/			Point Leamington	I	200
Leading Tickles South	I	125	*POINT OF BAY	I	50
				TOTAL	652

*DIVISION 3

Black Duck Cove	U	1	Kettle Cove	U	12
Bluff Head Cove	U	40	Little Harbour	U	11
Crow Head	I	75	Manuel's Cove	U	49
Durrell	I	300	Purcell's Harbour	U	22
Gillard's Cove	U	38	Ragged Point	U	28
			Twillingate	I	370
				TOTAL	946

DIVISION 4

Bridgeport	U	52	Moreton's Harbour	U	57
Carter's Cove	U	28	Newville	U	34
Chanceport	U	17	Pikes Arm	U	24
Cobb's Arm	U	40	Salt Harbour	U	26
Cottle's Island'			Summerford	I	245
Luke's Arm	I	80	Sunnyside	U	17
Fairbank	U	72	Tizzard's Harbour	U	35
Green Cove	U	3	Toogood Arm	U	25
Hatchet Harbour	U	13	Virgin Arm	U	162
*HILLGRADE	U	33	Whale's Gulch	U	50
Indian Cove	U	16			
Merritts Harbour	U	13		TOTAL	1,042

DIVISION 5

Birchy Bay	I	125	Port Albert	U	33
Boyd's Cove	U	96	*RODGERS COVE	U	24
Clarke's Head	U	97	Victoria Cove	U	63
Gayside	I	65	Wings Point	U	56
Horwood	U	128		TOTAL	687

DIVISION 6

Brown's Arm	U	63	Norris Arm	I	275
Campbellton	I	170	Peterview	I	180
Embree	I	200	Porterville	U	30
Lawrenceton	U	71	Rattling Brook	U	40
Little Burnt Bay	I	115	*STANHOPE	U	70
Loon Bay	U	34	Stoneville	U	92
Michael's Harbour	U	22			
Newstead/Comfort Cove	I	160		TOTAL	1,522

*DIVISION 7

Appleton	I	80	Glenwood	U	240
				TOTAL	320

UNIT 9

DIVISION 1

King's Point	I	170	Robert's Arm	I	235
La Scie	I	280	*SPRINGDALE	I	815
				TOTAL	1,500

DIVISION 2

*BAIE VERTE	I	540
TOTAL		540

DIVISION 3

*BRENT'S COVE	U	50	Purbeck's Cove	U	20
Coachman's Cove	I	60	Seal Cove	I	160
Fleur de Lys	I	125	The Beaches	U	35
Harbour Round	I	70	Westport	I	85
Ming's Bight	I	75	Wild Cove	U	36
Pacquet	I	85	Woodstock	U	65
				TOTAL	866

DIVISION 4

Burlington	I	80	Shoe Cove	U	53
Middle Arm	I	105	Smith's Harbour	U	43
*NIPPERS HARBOUR	U	65	Snooks Arm	U	14
Round Harbour	U	13	Tilt Cove	I	25
			TOTAL		398

DIVISION 5

*HARRY'S HARBOUR	U	56	Silverdale	U	11
Jackson's Cove	U	39	St. Patricks	U	4
*LITTLE BAY	I	80	Wild Bight	I	55
Nickey's Nose Cove	U	7	TOTAL		252

DIVISION 6

Beaumont/			Port Anson	I	32
Lushes Bight	I	105	South Brook	I	185
Brighton	U	62	*TRITON/JIMS COVE/		
Miles Cove	I	40	CARDS HARBOUR	I	230
Pilley's Island	I	115	TOTAL		769

UNITS 10, 11, 12

DIVISION 1

*BADGER	I	255
TOTAL		255

DIVISION 2

*BISHOP'S FALLS	I	1,010	Grenfell Heights	U	135
*GRAND FALLS/	I	2,235			
WINDSOR	I	1,350	TOTAL		4,730

DIVISION 3

Buchans	U	371	*MILLERTOWN	I	70
Buchans Company Town	I	120	Millertown Junction	U	8
Buchans Junction	U	64	TOTAL		633

UNIT 13

No population

UNIT 14

DIVISION 1

Black Duck	U	32	Noels Pond	U	36
Black Duck Brook	U	29	Point au Mal	U	28
Fox Island River	U	12	Romaines	U	55
Kippens	I	265	*STEPHENVILLE	I	2,330
			TOTAL		2,887

DIVISION 2

Abrahams Cove	U	22	Port au Port	I	200
Boswarlos	U	67	Port au Port West/		
Campbell's Creek	U	35	Aguathuna/		
Cape St. George	U	71	Felix Cove	I	200
DE GRAU	U	134	Red Brook	U	45
Lourdes	I	180	Salmon Cove	I	180
Lower Cove	U	33	Sheaves Cove	U	62
Mainland	U	83	Ship Cove	U	85
Marches Point	U	48	Three Rock Cove	U	81
Piccadilly	U	137	*WEST BAY	U	28
			*WEST BAY CENTRE	U	51
			Winterhouse	U	17
			TOTAL		1,767

DIVISION 3

Barachois Brook	U	79	Mattis Point	U	49
*FLAT BAY	U	84	St. George's	I	415
Flat Bay Brook	U	3	St. Theresa	U	34
Flat Bay West	U	22	St. Theresa Station	U	8
Gypsumville	U	2	Shallop Cove	U	2
Journois	U	5	Stephenville Crossing	I	480
			TOTAL		1,183

DIVISION 4

Cartyville	U	13	Maidstone	U	4
Fischells	U	2	McKay's	U	38
Heatherton	U	83	*ROBINSONS	U	62
Highlands	U	41	St. David's	U	77
Jeffrey's	U	62	St. Fintan's	U	36
Lockleven	U	18	TOTAL		436

DIVISION 5

Benoit's Siding	U	11	Millville	U	30
Cape Anguille	U	28	O'Regan's	U	37
Coal Brook	U	37	St. Andrew's	U	66
Codroy	U	67	Searston	U	44
Doyles	U	14	Tompkins	U	17
Great Codroy	U	28	Upper Ferry	U	35
Loch Lomond	U	6	*WOODVILLE	U	36
			TOTAL		456

DIVISION 6

Cape Ray	U	90	Grand Bay West	U	15
*CHANNEL PORT AUX BASQUES	I	1,460	South Branch	U	92
			TOTAL		1,657

DIVISION 7 - NOT SAMPLED

Burgeo	U	515	La Poile	U	44
Diamond Cove	U	27	Margaree	U	51
Fox Roost	U	30	Petites	U	23
Grand Bruit	U	16	Ramea	U	265
Grey River	U	45	Rose Blanche/		
Isle aux Morts	I	245	Harbour le Cou	I	260
			TOTAL		1,521

UNIT 15

DIVISION 1

*CORNER BROOK	I	6,100
TOTAL		6,100

DIVISION 2

*PASADENA	I	465
TOTAL		465

DIVISION 3

Dogwood	U	19	Pynns	U	20
John's Beach	U	43	South Brook	I	80
Lake Siding	U	77	Spillway	U	56
Little Harbour	U	3	Steady Brook	I	80
*LITTLE RAPIDS	U	50	TOTAL		428

DIVISION 4

Benoit's Cove	I	300	*LARK HARBOUR	I	185
Cox's Cove	I	205	Massey Drive	I	80
Frenchman's Cove	U	76	Meadows	I	150
Gallants	I	125	McIvers	I	85
Gillams1	I	120	*MOUNT MORIAH	I	135
Halfway Point	U	87	Summerside	I	195
Hughes Brook	I	35	York Harbour	I	75
Irishtown	I	150		TOTAL	1,903

UNIT 16

DIVISION 1

*DEER LAKE	I	1,060
TOTAL		1,060

DIVISION 2

*CORMACK	U	140	Reidville	I	75
Nicholsville	U	72	TOTAL		287

DIVISION 3

Galeville	U	21	Jackson's Arm	U	115
Georges Cove	U	6	Pollards Point	U	112
Hampden	I	145	*SOP'S ARM	U	90
Howley	I	95	TOTAL		584

UNIT 17 (No divisions)

Barr'd Harbour	U	3	Hawke's Bay	I	105
Bartletts Harbour	U	32	New Ferolle	U	27
Bellburns	I	35	Parsons Pond	I	115
Bird Cove	U	84	Port au Choix	I	225
Brig Bay	U	37	Portland Creek	U	20
Castors River	U	59	Port Saunders	I	150
*DANIEL'S HARBOUR	I	130	Reefs Harbour	U	22
*EDDIES COVE WEST	U	13	*RIVER OF PONDS	I	60
Great Harbour Deep	I	65	Three Mile Rock	U	25
			*SHOAL COVE VILLAGE	U	55
			TOTAL		1,262

UNIT 18

DIVISION 1

*ST. ANTHONY	I	715
TOTAL		715

DIVISION 2

Cape Norman	U	6	Raleigh	I	75
Cook's Harbour	I	75	St. Antonny Bight	U	43
Great Brehat	U	21	St. Carols	U	16
Goose Cove	U	5	St. Lunaire/Griquet	I	175
*GOOSE COVE EAST	U	76	Ship Cove	U	56
L'anse aux Meadows	U	15	Spillars Cove	U	13
Noddy Bay	U	18	Spillars Cove	U	27
North Boat Harbour	U	19	Wild Bight	U	8
*QUIRPON	U	42			
			TOTAL		690

DIVISION 3

*BIDE ARM	I	60	Northeast Crouse	U	5
*CONCHE	I	95	Pigeon Cove	U	17
Croque	U	30	Roddickton	I	225
Englee	I	220	St. Julien's	U	24
Main Brook	I	115			
			TOTAL		791

DIVISION 4

*ANCHOR POINT	I	70	Green Island Cove	U	49
Bear Cove	U	39	Lower Cove	U	7
Big Brook	U	4	Nameless Cove	U	26
*BLACK DUCK COVE	U	34	Payne's Cove	U	20
Blue Cove	U	19	Plum Point	U	35
Deadmans Cove	U	7	Pond Cove	U	14
Eddies Cove	U	23	St. Barbe	U	16
Flower's Cove	I	100	Sandy Cove	I	65
Forresters Point	U	54	Savage Cove	U	65
Green Island Brook	U	50	Shoal Cove Settlement	U	7
			TOTAL		714

APPENDIX 5

NUMBER OF HOUSEHOLDS CONTACTED AND RESPONSE TO "SERIOUS WOOD BURNER" QUALIFYING QUESTION

Town	Total phoned	Total contacted No.	%	Wood burners Serious 1977-78 ≥ .8 cds No.	%	Casual 1977-78 < .8 cds No.	%	Non-wood burners 1977-78 No.	%	New wood burners ≥ .8 cds 1978-79 No.	%
Management Unit 1											
St. John's	113	100	88	3	3	19	19	78	78	3	3
Dildo	54	41	76	15	37	7	17	19	46	5	12
Jerseyside	44	40	91	12	30	4	10	24	60	2	5
St. Joseph's	51	40	78	25	63	1	3	14	35	2	5
Tors Cove	47	40	85	16	40	4	10	20	50	2	5
Chapel Cove	49	43	88	8	19	6	14	29	67	3	7
Seal Cove	49	41	84	4	10	11	27	26	63	5	12
Burnt Point	48	40	83	11	27	0	0	29	93	4	10
Management Unit 2											
Clarenville/ Shoal Harbour	74	53	72	14	26	9	17	30	57	8	15
Bonavista	53	39	74	9	23	2	5	28	72	4	10
English Harbour	25	19	76	9	47	1	5	9	47	1	5
Goose Cove	13	12	92	2	17	2	17	8	67	0	0
Long Beach	30	23	77	20	87	1	4	2	9	2	9
Musgravetown	40	32	80	17	53	3	9	12	37	3	9
Management Unit 3											
Terrenceville	49	41	84	32	78	3	7	6	15	2	5
Red Harbour	50	40	80	28	70	2	5	10	25	4	10
Marystown	46	42	91	12	29	1	2	29	69	3	7
Burin	63	52	83	8	15	4	8	40	77	3	6
Lord's Cove	56	40	71	24	60	7	17	9	23	0	0
Grand Bank	52	43	83	4	9	6	14	33	77	4	9
Management Unit 5											
Aspen Cove/ Ladle Cove	48	40	83	34	85	0	0	6	15	4	10
Badger's Quay	47	37	79	11	30	1	3	25	68	3	8
Gambo	55	45	82	11	24	2	4	32	71	6	13
Gander	128	107	84	6	6	23	21	78	73	11	10
Eastport	45	38	84	16	42	6	16	16	42	5	13

APPENDIX 5 CONTINUED

Town	Total phoned	Total contacted No.	%	Wood burners Serious 1977-78 ≥ .8 cds No.	%	Casual 1977-78 < .8 cds No.	%	Non-wood burners 1977-78 No.	%	New wood burners ≥ .8 cds 1978-79 No.	%
Management Unit 7											
St. Alban's	43	40	93	34	85	0	0	6	15	2	5
Milltown	41	41	100	21	51	1	2	19	46	4	10
Hermitage	48	40	83	19	47	3	7	18	45	1	3
Pool's Cove	49	39	80	25	64	2	5	12	31	2	5
Harbour Breton	68	65	96	9	14	10	15	46	71	1	1
Management Unit 8											
Botwood	64	56	88	20	36	6	11	30	54	2	4
Point of Bay	41	34	83	23	68	1	3	10	29	4	12
Twillingate Isld.	52	42	81	15	36	8	19	19	45	1	2
Hillgrade	38	34	89	20	59	1	3	13	38	3	9
Rodger's Cove	19	16	84	9	56	0	0	7	44	3	19
Stanhope	52	40	77	24	60	0	0	16	40	3	7
Glenwood/ Appleton	42	37	88	10	27	2	5	25	68	4	11
Management Unit 9											
Springdale	63	50	79	20	40	3	6	27	54	6	12
Baie Verte	77	55	71	8	15	6	11	41	75	5	9
Brent's Cove	45	37	82	33	89	0	0	4	11	3	8
Nipper's Harbour	41	29	71	17	59	3	10	9	31	2	7
Harry's Harbour	42	35	83	34	97	0	0	1	3	0	0
Little Bay	40	33	83	23	70	1	3	9	27	1	3
Triton/Jim's Cove	42	40	95	31	77	0	0	9	23	1	3
Management Units 10, 11, 12											
Badger	41	37	90	17	46	1	3	19	51	4	11
Bishops Falls	66	60	91	9	15	6	10	45	75	5	8
Grand Falls/ Windsor	112	107	95	14	13	16	15	77	72	4	4
Millertown	47	46	98	12	26	3	7	31	67	4	9

APPENDIX 5 CONCLUDED

Town	Total phoned	Total contacted No.	%	Wood burners Serious 1977-78 ≥ .8 cds No.	%	Casual 1977-78 < .8 cds No.	%	Non-wood burners 1977-78 No.	%	New wood burners ≥ .8 cds 1978-79 No.	%
Management Unit 14											
Stephenville	78	54	69	9	17	6	11	39	72	3	6
De Grau	48	44	92	38	86	0	0	6	14	3	7
West Bay	24	21	87	17	81	0	0	4	19	2	9
Flat Bay	48	40	83	31	77	0	0	9	23	1	3
Robinson's	58	57	98	34	60	1	2	22	39	3	5
Woodville	24	24	100	18	75	0	0	6	25	2	8
Port aux Basques	63	48	76	1	2	4	8	43	90	4	8
Management Unit 15											
Corner Brook	152	106	70	8	7	18	17	80	75	6	6
Pasadena	66	57	86	8	14	9	16	40	70	14	25
Little Rapids	47	30	64	15	50	2	7	13	43	4	13
Lark Harbour	40	31	77	9	29	1	3	21	68	3	10
Mount Moriah	47	40	85	12	30	3	7	25	63	6	15
Management Unit 16											
Deer Lake	56	46	82	11	24	2	4	33	72	3	6
Cormack	39	33	85	12	36	1	3	20	61	4	12
Sop's Arm	37	36	97	23	64	0	0	13	36	0	0
Management Unit 17											
Daniel's Harbour	40	32	80	7	22	0	0	25	78	3	9
Eddie's Cove West	12	10	83	6	60	0	0	4	40	0	0
River of Ponds	36	30	83	11	37	0	0	19	63	6	20
Shoal Cove West	34	33	97	5	15	0	0	28	85	0	0
Management Unit 18											
St. Anthony	61	49	80	8	16	3	6	38	78	4	8
Goose Cove	35	28	80	8	29	0	0	20	71	3	11
Quirpon	27	24	89	7	29	0	0	17	71	3	13
Bide Arm	37	34	92	33	97	0	0	1	3	1	3
Conche	39	29	74	19	65	1	3	9	31	0	0
Anchor Point	40	37	93	1	3	3	8	33	89	0	0
Black Duck Cove	39	32	82	3	9	1	3	28	87	3	9

APPENDIX 6

SAMPLE ANALYSIS OF VOLUME DATA FROM UNIT 16

Original data

Unit 1	Volume X (cords)							
Division 1, Deer Lake	2.0	4.0	5.2	6.0	3.2	1.0	6.0	
" 2, Cormack	13.0	4.0	4.8	9.0	1.6	4.0	4.0	1.0
" 3, Sops Arm	7.5	2.5	6.0	6.0	3.0	3.8	5.0	12.0

Transformed data

$Y = \sqrt{X + 0.5}$

									$\bar{Y}$	s	n
Division 1	1.58	2.12	2.39	2.55	1.92	1.22	2.55		2.05	0.51	7
Division 2	3.67	2.12	2.30	3.08	1.45	2.12	2.12	1.22	2.26	0.80	8
Division 3	2.83	1.73	2.55	2.55	1.87	2.08	2.35	3.54	2.44	0.58	8
									2.26	0.64	23

1. Grand total = 51.91
2. Sum of squared observations = 126.08
3. Sum of squared group (town) total divided by n = 117.73
4. Grand total squared and divided by total sample size = 117.16
5. SS_{total} = 2-4 = 8.92
6. SS_{towns} = 3-4 = 0.57
7. SS_{within} = 5-6 = 8.35

ANOVA

S.V.	S.S.	D.F.	M.S.	F.R.	
Between towns	0.57	2	0.29	0.68	NS
Within towns	8.35	20	0.42		
Total	8.92	22			

Since there is no significant difference between the towns at the 5% level the overall mean and standard deviation can be used. When a transformation is applied, tests of significance are performed on the transformed data. The mean is retransformed for presentation. Retransformation of the standard error would be misleading as it would be asymmetrical since the transformation $\sqrt{X + 0.5}$ is non-linear. Thus the asymmetrical 95% confidence limits are retransformed along with the mean.

$\bar{Y} = 2.26$

$s = 0.64$

95% confidence limits

$$L_1 = \bar{Y} - \text{to } .05 \frac{s}{\sqrt{n}} = 2.26 - \left(\frac{2.074 \times 0.64}{4.80}\right) = 1.98$$

$$L_2 = \bar{Y} - \text{to } .05 \frac{s}{\sqrt{n}} = 2.54$$

Transformed $\bar{Y} = 2.26 \quad L_1 = 1.98 \quad L_2 = 2.54$

Retransformed $\bar{X} = 4.61$ Lower = 3.42 Upper = 5.95

Means and confidence limits are converted from cords to cubic metres using the ratio 1 cord equals 3.62456 m^3 and presented in Table 3.

APPENDIX 7

SUMMARY OF ANALYSIS OF VARIANCE FOR ALL SAMPLED FOREST MANAGEMENT UNITS

SV = Source of variation
DF = Degrees of freedom
SS = Sum of squares
MS = Mean square
FR = F ratio
NS = Not significant at 5% level
* = Significant at 5% level
** = Significant at 1% level

SV	SS	DF	MS	FR	
Between towns in Unit 1	4.6	6	0.77	2.10	NS
Within towns (error)	14.21	39	0.36		
TOTAL	18.81	45			
Between towns in Unit 2	1.83	5	0.36	0.76	NS
Within towns (error)	13.45	28	0.48		
TOTAL	15.28	33			
Between towns in Unit 3	1.60	5	0.32	1.42	NS
Within towns (error)	7.22	32	0.23		
TOTAL	8.82	37			
Between towns in Unit 5	3.07	4	0.77	2.71	NS
Between Aspen Cove and Badger's Quay	(1.17)	(1)	1.17	4.18	NS
Within towns (error)	8.52	30	0.28		
TOTAL	11.59	34			
Between towns in Unit 7	2.15	4	0.54	1.82	NS
Between St. Alban's and Hr. Breton	(2.01)	(1)	2.01	6.70	NS
Within towns (error)	9.52	32	0.30		
TOTAL	11.67	36			

NB: St. John's is excluded.

Note: Volume in cords used for analysis purposes.

SV	SS	DF	MS	FR	
Between towns in Unit 8	12.06	6	2.01	5.44	*
(1+3) (4+6) (2+7) (5)	(10.20)	(3)	3.40	9.19	*
Between Botwood and Twillingate	(0.04)	(1)	0.04	0.11	NS
Between Hillgrade and Stanhope	(0.97)	(1)	0.97	2.62	NS
Between Point of Bay and Glenwood	(0.85)	(1)	0.85	2.30	NS
Within towns (error)	16.99	46	0.37		
TOTAL	29.05	52			
Between towns in Unit 9	8.83	6	1.47	2.66	NS
Within towns (error)	24.29	44	0.55		
TOTAL	33.12	50			
Between towns in Units 10, 11, 12	2.78	3	0.93	2.44	NS
Within towns (error)	8.76	23	0.38		
TOTAL	11.54	26			
Between towns in Unit 14	12.44	5	2.49	5.24	*
De Grau, West Bay & Woodville	(1.42)	(2)	0.71	1.51	NS
Flat Bay and Robinsons	(0.02)	(1)	0.02	0.03	NS
Within towns (error)	18.03	38	0.47		
TOTAL	30.47	43			
Between towns in Unit 15	2.25	4	0.56	2.30	NS
Corner Brook vs all other towns	(2.16)	(1)	2.16	8.64	NS
All other towns	(0.09)	(3)	0.03	0.12	NS
Within towns (error)	7.84	32	0.25		
TOTAL	10.09	36			
Between towns in Unit 16	0.57	2	0.28	0.72	NS
Within towns (error)	7.78	20	0.39		
TOTAL	8.35	22			
Between towns in Unit 17	2.04	3	0.68	0.73	NS
Within towns (error)	17.66	19	0.93		
TOTAL	19.70	22			
Between towns in Unit 18	7.22	5	1.44	3.40	NS
Within towns (error)	12.30	29	0.42		
TOTAL	19.52	34			

Critical Value of F Distribution at 5% Level of Significance

(From Rohlf and Sokal)

V_2 \ V_1	20	30	40	50
1	248	250	251	252
2	19.4	19.5	19.5	19.5
3	8.66	8.62	8.59	8.58
4	5.80	5.75	5.72	5.70
5	4.56	4.50	4.46	4.44
6	3.87	3.81	3.77	3.75

V_1 = degrees of freedom of numerator mean square.

V_2 = degrees of freedom of denominator mean square.

APPENDIX 8

Estimated Number of Fuelwood Burning Households by Division Within Forest Management Unit, and the Island of Newfoundland for the years 1977-78 and 1978-79

Unit		Number contacted	Number serious burners 1977-78	Number serious burners 1978-79	Population	Estimated number serious burners 1977-78	Estimated number serious burners 1978-79
1	Div. 1	excluded					
	" 2	161	68	79	14,538	6,140	7,134
	" 3	84	12	20	6,361	909	1,515
	" 4	40	11	15	7,822	2,151	2,933
	Total				28,721	9,200	11,582
2.	Div. 1	53	14	22	1,000	264	415
	" 2	39	9	13	1,155	267	385
	" 3	86	48	54	5,507	3,074	3,458
	Total				7,662	3,605	4,258
3.	Div. 1	41	32	34	275	215	228
	" 2	40	28	32	1,414	990	1,131
	" 3	42	12	15	1,442	412	515
	" 4	52	8	11	998	154	211
	" 5	40	24	24	1,044	626	626
	" 6	43	4	8	1,565	146	291
	Total				6,738	2,543	3,002
5.	Div. 1	40	34	38	376	626	699
	" 2	37	11	14	1,553	462	588
	" 3	45	11	17	1,590	389	601
	" 4	107	6	17	2,350	132	373
	" 5	38	16	21	1,149	484	635
	" 6	excluded					
	Total				7,378	2,093	2,896
7.	Div. 1	40	34	36	585	497	527
	" 2	41	21	25	283	145	173
	" 3	79	44	47	571	318	340
	" 4	65	9	10	1,133	157	174
	Total				2,572	1,117	1,214

Unit	Number contacted	Number serious burners 1977-78	1978-79	Population	Estimated number serious burners 1977-78	1978-79
8. Div. 1	56	20	22	2,000	714	786
" 2	34	23	27	652	441	518
" 3	42	15	16	946	338	360
" 4	34	20	23	1,042	613	705
" 5	16	9	12	687	386	515
" 6	40	24	27	1,522	913	1,027
" 7	37	10	14	320	86	121
Total				7,169	3,491	4,032
9. Div. 1	50	20	26	1,500	600	780
" 2	55	8	13	540	79	128
" 3	37	33	36	866	772	843
" 4	29	17	19	398	233	261
" 5	68	57	58	252	211	215
" 6	40	31	32	769	596	615
Total				4,325	2,491	2,842
10, 11 & 12						
Div. 1	37	17	21	255	117	145
" 2	167	23	32	4,730	651	906
" 3	46	12	16	633	165	220
Total				5,618	933	1,271
14. Div. 1	54	9	12	2,787	465	619
" 2	65	55	60	1,767	1,495	1,631
" 3	40	31	32	1,183	917	946
" 4	57	34	37	436	260	283
" 5	24	18	20	456	342	380
" 6	excluded					
" 7	excluded					
Total				6,629	3,479	3,859
15. Div. 1	106	8	14	6,100	460	806
" 2	57	8	22	465	65	179
" 3	30	15	19	428	214	271
" 4	71	21	30	1,903	563	804
Total				8,896	1,302	2,060

Unit	Number contacted	Number serious burners 1977-78	1978-79	Population	Estimated number serious burners 1977-78	1978-79
16. Div. 1	46	11	14	1,060	253	323
" 2	33	12	16	287	104	139
" 3	36	23	23	584	373	373
Total				1,931	730	835
17. (No Divisions)						
	105	29	38	1,262	349	457
Total				1,262	349	457
18. Div. 1	49	8	12	715	117	175
" 2	52	15	21	690	199	279
" 3	63	52	53	791	668	665
" 4	69	4	7	704	41	71
Total				2,900	1,025	1,190
Total for island[a]					32,358	39,498

[a]Does not include Unit 1, Division 1
Unit 5, Division 6
Unit 14, Division 6 & 7
Towns in Gros Morne Park

APPENDIX 9

ANCILLARY DATA OF WOODFUEL BURNING HABITS AND OPINIONS FOR EACH COMMUNITY SAMPLED IN EACH FOREST MANAGEMENT UNIT

Mgmt. Unit 1		Type of Woodburning Unit							Sources of Heat				Year Started Burning Wood						Reasons for Burning Wood		Employment (Head Hshld.)			Distance Travelled to Obtain Wood (One Way)					Expected Wood Consumption in 78-79 Compared to 77-78			
TOWN	No. sampled	Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Price of alternative heating	Other	Seasonal	Full time	Not employed	Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	More	Less	Same	Stop burning
St. John's	(2)						2				2		2							2	1	1				1	1				2	
Dildo	(7)		1	6							5	2	6					1	5	2	3	1	3	6		1					7	
Jerseyside	(5)	1		4						1	3	1	5						4	1	2	1	2	4				1			5	
St. Joseph's	(7)		3	4					2	1	2	2	5		1		1		5	3	4	1	2	6	1						7	
Tor's Cove	(8)			6		2				4	3	1	6				1	1	5	2	2	4	2	6		2			1		7	
Chapel Cove	(8)		1	7						2	1	5	7			1			4	4	4	2	2		2	5		1			8	
Seal Cove	(3)	2				1			1	1	1		3						2	1			3		1	1		1	1		2	
Burnt Point	(8)	2	1	4		1				3	4	1	4				1	3	5	3	4	1	3	2	4	1		1		1	7	
TOTAL	(48)	5	6	31		6			3	12	21	12	38		1	1	3	5	30	18	20	11	17	24	8	11	1	4	2	1	45	

Mgmt. Unit 2

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Clarenville/ Shoal Harbour	(7)	1	2	1	1	1	1		1	4	2		1				4	2	7		1	6		5		2			3		4	
Bonavista	(7)		3	3	2					2	5		6				1		3	4	3	3	1	4		3			2		5	
English Harbour	(7)		1	6						1	5	1	5			1		1	5	2	1	1	5	1	1	2	3		1	1	4	1
Goose Cove	(2)		2							2			2						1	1		1	1	2							2	
Long Beach	(7)	4	2	1							7		5				1	1	5	2	4		3	7					1		6	
Musgravetown	(4)	2	1	1	1		1			2	1	1	3	1					2	2		3	1	2	2					1		3	
TOTAL	(34)	7	11	12	4	1	2		1	11	20	2	22	1		1	6	4	23	11	9	14	11	21	3	7		3	8	1	24	1

Mgmt. Unit 3

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Terrenceville	(8)			8						4	4		8						7	1	4	1	3	1	2	4		1			8	
Red Harbour	(7)	1		5		1				6	1		7						1	6	4	1	2	7							7	
Marystown	(7)		1	6					1	5	1		5					2	3	4	2	3	2	4	1	1	1				7	
Burin	(6)		1	3	1		1		2	3	1		4					2	3	3	1	3	2	2	2	2			1		5	
Lord's Cove	(8)			8						5	3		8						4	4	2	1	5	7	1						8	
Grand Bank	(2)						2			2			1					1	2			2			1			1			2	
TOTAL	(38)	1	2	30	1	1	3		3	25	10		33					5	20	18	13	11	14	21	7	7	3		1		37	

Mgmt. Unit 5

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Aspen Cove/ Lydle Cove	(8)	3	1	2		2			1		7		6					2	3	5	3	2	3	4	3			1	3		5	
Badger's Quay	(7)		1	6						1	6		5					2	6	1	4	3		1	2	4			1		6	
Gambo/Dark Cove Middle Brook	(7)	2	1	2	1	1	1			1	6		5					2	4	3		3	4	3	1	3			1		6	
Gander	(6)		3			1	4			1	5		2				1	3	3	3		6		4	1		1		1		5	
Eastport	(7)	2	2	4						1	6		7						5	2	4	1	2	5	1		1				7	
TOTAL	(35)	7	8	14	1	4	5		1	4	30		25				1	9	21	14	11	15	9	17	8	7	2	1	6		29	

Mgmt. Unit 7

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
St. Albans	(7)	3	2	4						2	2	3	7						6	1	3	2	2	7							7	
Milltown	(7)	1	1	3			1	1		3	4		4				2	1	5	2	2	3	2	5	1			1	3		4	
Hermitage	(9)	3	1	5						1	6	2	5				2	2	8	1	1	5	3	2	3	1	2	1	3		6	
Pool's Cove	(7)		4	2		1			1		4	2	2	1		1		3	5	2		7		2	2	3			1		6	
Harbour Breton	(7)	1		4		2				1	6		4					3	4	3	1	5	1	2	2	3			2		5	
TOTAL	(37)	8	8	18		3	1	1	1	7	22	7	22	1		1	4	9	28	9	7	22	8	18	8	7	2	2	9		28	

Mgmt. Unit 8

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Botwood	(7)	2	4		1					5	2		2				3	2	7		2	4	1		2			2	2	1	4	
Point of Bay	(8)	2	2	1		3	1			1	7		5				3		7	1	4	2	2	5			2	1			8	
Twillinate Island	(9)		2	7						4	3	2	7	1				1	5	4	7	1	1				8	1	2		7	
Hillgrade	(8)	3	1	5					2	1	4	1	6	1				1	3	5	7	1				4	4		2		6	
Rodger's Cove	(7)	3	4		1				1	2	4		5					2	7		3	2	2	7							7	
Stanhope	(7)	2	3	3					2		5		7						6	1	5		2	7					1	1	5	
Glenwood/ Appleton	(7)	2	2	1			3		1	3	3		3					4	4	3	2	4	1	4	2	1			3		4	
TOTAL	(53)	14	18	17	2	3	4		6	16	28	3	35	2			6	10	39	14	30	14	9	23	4	8	14	4	10	2	41	

Mgmt. Unit 9

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Springdale	(8)	1	6	2		1				2	6		3	1		1	3		8		2	3	3		3	4		1	4		4	
Baie Verte	(7)	1	5		1				1	3	3					2	5		6	1		7		4	3				3		4	
Brent's Cove	(7)	4		3						1	6		6		1				6	1	4	2	1	7					2		5	
Nippers Hr.	(7)	4		2		1					7		5	1	1				5	2	4	2	1	2	4			1	3		4	
Harry's Hr.	(7)	4	4	1					2	1	4		3		4				6	1	5	2		1	6				1		6	
Little Bay	(8)	1	2	2		3				1	7		2	1		2	3		7	1	4	1	3	3	3		1	1	2	1	5	
Triton/ Jim's Cove	(7)	3	3	2				1		1	6		5			1	1		6	1	4	1	2	1	1	4	1		3		4	
TOTAL	(51)	18	20	12	1	5		1	3	9	39		24	3	6	6	12		44	7	23	18	10	18	20	8	2	3	18	1	32	

Mgmt. Unit 10,11,12

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Badger	(8)		6	1		1			1	2	5		1				1	6	8		2	4	2	1	5	2				1	7	
Bishops Falls	(4)	1	2	1						1	2	1	3					1	3	1	1	1	2		2	1		1			4	
Grand Falls/ Windsor	(7)	1	3	2		1				1	5	1	3				1	3	6	1	1	6		2	2			3	4	1	2	
Millertown	(8)		5	3						2	5	1	1	2		1		4	8		5	1	2	6	2				3	1	3	1
TOTAL	(27)	2	16	7		2			1	6	17	3	8	2		1	2	14	25	2	9	12	6	9	11	3		4	7	3	16	1

Mgmt. Unit 14

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Stephenville	(8)		4	3			1			2	5	1	4				1	3	5	3	2	2	4	2			3	3	3	1	4	
De Grau	(7)	1	3	3						1	6		4		1	2			6	1	4	2	1	4	1		2		2		5	
West Bay	(8)	1	4	2	1				1	3	3	1	3		2	1		2	6	2	3	4	1	6	1			1	3		5	
Flat Bay	(7)		1	6						1	5	1	7						4	3	3	1	3	3	1	3			1	2	4	
Robinson's	(7)	3	3	1						4	3		5		1		1		6	1	3	2	2	2		1	4		1		6	
Woodville	(7)	1	2	3		2			3		4		6				1		5	2	3	3	1	7					1	1	5	
Port aux Basques	(1)		1															1	1			1						1			1	
TOTAL	(45)	6	18	18	1	2	1		4	11	27	3	29		4	3	3	6	33	12	18	15	12	24	3	4	9	5	11	4	30	

Mgmt. Unit 15

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Corner Brook	(7)		4			1	2			2	4	1			2		2	3	3	4	1	5	1	1	2	3	1		2	5		
Pasadena	(7)		5			2			1	4	2						2	5	5	2		5	2	6	1				2	5		
Little Rapids	(7)		4		1	2	2		1	2	4		2			3		2	4	3	2	2	3	7						7		
Lark Harbour	(9)	3	4	2					1	1	7		5					4	8	1	7		2	4	5				2	7		
Mount Moriah	(7)		4	1		1	1			2	5			1			1	5	5	2	3	4		2	1		4		2	5		
TOTAL	(37)	3	21	3	1	6	5		3	11	22	1	7	1	2	3	5	19	25	12	13	16	8	20	9	3	5		8	29		

Mgmt. Unit 16

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Deer Lake	(7)	1	5	1					1	3	3		3		1		1	2	4	3	1	5	1	1	4	2			1		6	
Cormack	(8)		4	1	1	1	1		1	1	6		3			1	1	3	8		3	3	2	7		1			4		4	
Sop's Arm	(8)	3	4	1							8		6					2	6	2	6	1	1	8					1	1	6	
TOTAL	(23)	4	13	3	1	1	1		2	4	17		12		1	1	2	7	18	5	10	9	4	16	4	3			6	1	16	

Mgmt. Unit 17

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
Daniel's Hr.	(7)	5	1				1			3	4		5					2	6	1	2	3	2	4	3				4		3	
Eddies Cove W.	(5)		4	1							5		3				1	1	5		4		1	5						5	
River of Ponds	(7)	2	1	3			1			1	6		6					1	3	4	5	1	1	4	2	1				7		
Shoal Cove	(5)	1	3	1							5		5						3	2	4		1			4	1			4	1	
TOTAL	(24)	8	9	5			2			4	20		19				1	4	17	7	15	4	5	13	5	5	1		4	19	1	

Mgmt. Unit 18

TOWN	No. sampled	Type of Woodburning Unit: Wood stove (heating and cooking)	Wood stove (heating)	Wood & oil stove	Wood furnace	Wood & oil furnace	Fireplace	Other	Sources of Heat: Wood only	Wood & electricity	Wood & oil	Wood, electricity, oil	Year Started Burning Wood: Before 31 March 1973	1973-74	1974-75	1975-76	1976-77	1977-78	Reasons for Burning Wood: Price of alternative heating	Other	Employment (Head Hshld.): Seasonal	Full time	Not employed	Distance Travelled to Obtain Wood (One Way): Less than 5 miles	6-10 miles	11-20 miles	21+ miles	Bought (distance unknown)	Expected Wood Consumption in 78-79 Compared to 77-78: More	Less	Same	Stop burning
St. Anthony	(7)	1	3	3						7			4			1	2		5	2	3	3	1		5	2			2	5		
Goose Cove	(6)		1	5						6			5		1				3	3	3	2	1		2	4			1	4	1	
Quirpon	(7)		4	2				1		7			4				3		3	4	5	1	1			7			2	4	1	
Bide Arm	(7)		6	3	1				1	6			7						7		3	2	2	5	1	1			1	6		
Conche	(5)	3		4	1					5			5						5		4		1	3	1	1			1	4		
Anchor Point	(0)																															
Black Duck Cove	(3)				2			1		3						1	2		3		2	1		1		1	1			3		
TOTAL	(35)	4	14	17	4			2	1	34			25		1	2	7		26	9	20	9	6	9	9	16	1		7	26	2	

APPENDIX 10

REPORTED VOLUME OF HARDWOOD AND SOFTWOOD CONSUMED BY EACH RESPONDENT FOR THE YEAR 1977-78

Management Unit 1

Interview Number	St. John's			Dildo			Jerseyside			St. Joseph's			Tors Cove			Chapel Cove			Seal Cove			Burnt Point		
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	1.6	0.0	1.6	0.0	2.8	2.8	0.4	2.0	2.4	0.0	6.0	6.0	0.8	3.2	4.0	0.0	0.8	0.8	0.4	1.6	2.0	0.4	9.6	10.0
2	0.8	0.8	1.6	0.0	2.8	2.8	0.8	2.8	3.6	0.4	10.0	10.4	0.0	4.4	4.4	0.4	2.8	3.2	1.2	0.8	2.0	0.0	1.4	1.4
3				0.0	3.5	3.5	0.8	2.8	3.6	0.0	6.0	6.0	0.8	0.8	1.6	0.2	1.0	1.2	0.0	0.8	0.8	1.2	0.4	1.6
4				0.4	3.6	4.0	0.5	2.0	2.5	0.0	8.0	8.0	1.5	8.5	10.0	0.0	2.6	2.6				0.0	0.8	0.8
5				0.0	3.4	3.4	0.5	1.0	1.5	0.4	9.6	10.0	1.2	0.0	1.2	1.0	7.0	8.0				0.6	7.4	8.0
6				0.4	2.0	2.4				0.0	1.2	1.2	1.4	4.4	5.8	0.0	7.0	7.0				0.0	0.8	0.8
7				0.4	2.8	3.2				0.0	6.0	6.0	0.4	1.2	1.6	0.8	0.8	1.6				0.0	0.8	0.8
8													2.2	0.0	2.2	0.0	1.6	1.6				0.0	2.4	2.4
9																								

Note: Volumes for all management units in Appendix 10 are given in cords.

Management Unit 2

Interview Number	Clarenville			Bonavista			English Harbour			Goose Cove			Long Beach			Musgravetown								
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	1.5	1.5	3.0	0.0	1.5	1.5	2.5	2.8	5.3	1.0	1.0	2.0	0.0	3.5	3.5	1.5	1.0	2.5						
2	2.4	0.4	2.8	0.4	4.0	4.4	0.0	1.0	1.0	1.0	3.0	4.0	0.0	8.0	8.0	3.5	0.0	3.5						
3	0.4	3.2	3.6	0.0	2.0	2.0	0.0	1.2	1.2				0.0	2.0	2.0	0.0	3.5	3.5						
4	1.6	6.4	8.0	1.0	9.0	10.0	0.0	4.4	4.4				0.0	3.0	3.0	1.5	0.0	1.5						
5	0.0	0.4	0.4	0.0	0.8	0.8	0.8	2.0	2.8				0.0	12.0	12.0									
6	1.6	0.0	1.6	0.0	5.0	5.0	0.4	2.0	2.4				0.0	12.0	12.0									
7	2.5	0.5	3.0	1.0	9.0	10.0	0.0	6.0	6.0				0.0	1.5	1.5									
8																								
9																								

Management Unit 3

	Terrenceville			Red Harbour			Marystown			Burin			Lord's Cove			Grand Bank								
1	0.0	0.8	0.8	0.0	1.0	1.0	0.0	6.0	6.0	0.0	1.0	1.0	0.0	2.0	2.0	1.2	0.4	1.6						
2	0.5	1.0	1.5	0.0	3.2	3.2	0.0	0.8	0.8	0.0	6.5	6.5	0.0	0.8	0.8	0.0	1.2	1.2						
3	2.0	2.0	4.0	0.0	0.8	0.8	0.0	4.0	4.0	0.0	2.6	2.6	0.0	2.0	2.0									
4	0.4	1.6	2.0	0.0	1.0	1.0	0.0	3.0	3.0	0.0	0.8	0.8	0.0	1.6	1.6									
5	0.6	1.8	2.4	0.0	2.0	2.0	0.0	7.0	7.0	0.4	1.2	1.6	0.0	4.0	4.0									
6	0.4	0.4	0.8	0.0	3.5	3.5	0.0	1.5	1.5	0.0	5.0	5.0	0.0	2.8	2.8									
7	1.0	3.0	4.0	0.0	2.5	2.5	0.0	8.0	8.0				0.0	2.8	2.8									
8	1.2	1.2	2.4										0.0	4.0	4.0									
9																								

Management Unit 5

Interview Number	Aspen Cove and Ladle Cove			Badger's Quay			Gambo			Gander			Eastport								
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	0.0	6.0	6.0	0.0	2.6	2.6	0.0	4.5	4.5	1.0	0.0	1.0	0.0	6.0	6.0						
2	0.0	3.5	3.5	0.0	3.6	3.6	2.0	3.0	5.0	1.2	0.0	1.2	0.6	1.2	1.8						
3	0.4	2.0	2.4	0.0	1.2	1.2	0.0.	1.0	1.0	0.8	0.0	0.8	4.0	6.0	10.0						
4	0.0	8.0	8.0	0.0	4.0	4.0	0.0	1.0	1.0	0.6	0.6	1.2	0.5	0.5	1.0						
5	0.0	1.6	1.6	0.4	0.8	1.2	2.5	2.5	5.0	2.0	0.0	2.0	0.8	0.4	1.2						
6	0.0	4.0	4.0	0.0	1.6	1.6	0.0	1.2	1.2	0.8	0.8	1.6	3.2	0.4	3.6						
7	0.0	5.6	5.6	0.0	1.2	1.2	4.0	4.0	8.0				0.5	4.0	4.5						
8	1.0	3.0	4.0																		
9																					

Management Unit 7

	St. Alban's			Milltown			Hermitage			Pool's Cove			Harbour Breton								
1	3.0	3.0	6.0	1.6	0.0	1.6	0.0	5.0	5.0	1.0	3.0	4.0	1.0	1.0	2.0						
2	1.0	1.0	2.0	2.0	2.0	4.0	2.5	5.5	8.0	4.0	2.0	6.0	1.4	1.4	2.8						
3	1.0	1.0	2.0	1.0	2.0	3.0	2.0	0.0	2.0	4.0	0.0	4.0	0.8	0.4	1.2						
4	0.0	12.0	12.0	2.2	0.0	2.2	2.0	0.0	2.0	3.0	1.0	4.0	1.2	5.6	6.8						
5	1.0	5.0	6.0	6.0	4.0	10.0	0.4	1.6	2.0	1.2	1.2	2.4	0.0	1.2	1.2						
6	0.0	6.0	6.0	4.0	2.0	6.0	2.0	3.0	5.0	0.8	2.0	2.8	0.5	2.0	2.5						
7	5.5	5.5	11.0	4.5	0.0	4.5	1.0	2.0	3.0	3.0	3.5	6.5	0.0	3.5	3.5						
8							1.0	2.0	3.0												
9							1.0	2.5	3.5												

Management Unit 8

Interview Number	Botwood			Point of Bay			Twillingate Is.			Hillgrade			Rodger's Cove			Stanhope			Glenwood/Appleton					
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	1.5	0.5	2.0	5.0	0.5	5.5	0.0	2.0	2.0	1.6	4.8	6.4	2.0	1.0	3.0	2.5	2.5	5.0	1.5	0.0	1.5			
2	0.8	0.4	1.2	6.0	0.0	6.0	1.2	0.8	2.0	1.6	0.4	2.0	3.0	2.0	5.0	0.0	3.0	3.0	1.6	0.0	1.6			
3	0.4	0.8	1.2	3.5	3.5	7.0	0.8	1.6	2.4	3.2	3.2	6.4	10.0	0.0	10.0	2.0	3.0	5.0	5.0	5.0	10.0			
4	2.0	0.5	2.5	6.0	2.0	8.0	0.4	0.4	0.8	0.5	4.5	5.0	1.0	11.0	12.0	0.0	12.0	12.0	0.5	0.5	1.0			
5	0.4	0.8	1.2	2.0	4.0	6.0	1.2	0.0	1.2	1.2	4.8	6.0	0.0	12.0	12.0	3.0	6.0	9.0	8.0	0.0	8.0			
6	1.0	4.5	5.5	3.0	0.0	3.0	1.0	0.0	1.0	0.0	0.8	0.8	2.0	2.0	4.0	6.0	4.0	10.0	2.0	1.0	3.0			
7	1.0	1.5	2.5	4.5	5.0	9.5	1.2	1.2	2.4	4.0	5.0	9.0	12.0	0.0	12.0	0.0	5.0	5.0	0.4	1.6	2.0			
8				0.5	0.5	1.0	0.8	2.4	3.2	0.0	1.5	1.5												
9							1.8	0.6	2.4															

Management Unit 9

	Springdale			Baie Verte			Brent's Cove			Nipper's Harbour			Harry's Harbour			Little Bay			Triton/Jim's Cove					
1	5.5	0.0	5.5	9.0	2.0	11.0	1.5	9.0	10.5	0.2	5.0	5.2	6.0	6.0	12.0	1.0	11.0	12.0	4.0	4.0	8.0			
2	3.0	3.0	6.0	1.5	0.5	2.0	2.0	0.0	2.0	0.4	4.0	4.4	5.0	5.0	10.0	11.0	1.0	12.0	0.0	12.5	12.5			
3	13.0	2.0	15.0	0.8	1.4	2.2	0.0	2.8	2.8	0.0	3.2	3.2	5.5	0.5	6.0	6.0	2.0	8.0	3.5	3.5	7.0			
4	5.0	0.0	5.0	0.5	0.5	1.0	2.0	4.0	6.0	0.8	3.2	4.0	5.0	10.0	15.0	0.0	4.0	4.0	1.8	1.8	3.6			
5	10.0	5.0	15.0	0.8	0.8	1.6	2.0	8.0	10.0	0.0	3.5	3.5	4.0	4.0	8.0	4.0	3.0	7.0	1.0	1.0	2.0			
6	6.5	0.0	6.5	1.2	0.6	1.8	3.0	7.0	10.0	0.5	1.0	1.5	1.0	6.0	7.0	2.0	0.0	2.0	6.0	6.0	12.0			
7	6.0	2.0	8.0	2.0	3.5	5.5	0.0	1.0	1.0	2.0	0.0	2.0	3.0	0.5	3.5	3.0	3.0	6.0	2.0	7.0	9.0			
8	2.0	0.0	2.0													6.0	2.0	8.0						
9																								

Management Unit 10, 11 & 12

Interview Number	Badger			Bishop Falls			Grand Falls/Windsor			Millertown											
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	10.0	0.0	10.0	2.5	2.5	5.0	2.5	1.0	3.5	8.5	0.0	8.5									
2	5.5	1.5	7.0	1.0	4.5	5.5	1.0	2.5	3.5	10.0	2.0	12.0									
3	3.5	0.0	3.5	0.4	3.0	3.4	1.0	0.0	1.0	1.0	5.0	6.0									
4	3.0	3.0	6.0	2.0	1.0	3.0	2.5	2.5	5.0	2.0	0.0	2.0									
5	2.0	2.0	4.0				0.5	0.5	1.0	0.4	0.4	0.8									
6	4.0	4.0	8.0				2.4	0.8	3.2	3.0	1.0	4.0									
7	7.0	1.5	8.5				3.0	1.0	4.0	5.0	5.0	10.0									
8	6.0	2.0	8.0							1.0	0.0	1.0									
9																					

Management Unit 14

	Stephenville			De Grau			West Bay			Flat Bay			Robinson's			Woodville			Port aux Basques		
1	3.2	0.8	4.0	0.0	13.5	13.5	3.5	16.0	19.5	7.5	0.0	7.5	3.6	0.0	3.6	0.0	4.0	4.0	0.0	2.0	2.0
2	1.2	0.0	1.2	2.0	9.0	11.0	3.0	7.0	10.0	2.0	0.5	2.5	2.5	0.0	2.5	0.0	11.0	11.0			
3	2.4	0.0	2.4	3.4	0.0	3.4	1.2	0.0	1.2	3.0	1.0	4.0	0.4	0.4	0.8	0.0	7.0	7.0			
4	0.5	3.5	4.0	0.0	2.0	2.0	1.5	5.5	7.0	0.0	1.0	1.0	3.2	2.8	6.0	0.4	10.0	10.4			
5	3.2	0.4	3.6	0.0	12.0	12.0	1.5	13.5	15.0	1.0	2.0	3.0	4.0	0.8	4.8	0.0	5.0	5.0			
6	2.0	0.5	2.5	3.0	2.0	5.0	1.0	14.0	15.0	0.5	5.5	6.0	0.0	5.0	5.0	0.8	6.0	6.8			
7	2.0	0.0	2.0	9.0	1.0	10.0	3.0	4.0	7.0	2.0	3.0	5.0	3.0	1.0	4.0	2.0	1.0	3.0			
8	0.8	0.4	1.2				2.0	10.0	12.0												
9																					

Management Unit 15

Interview Number	Corner Brook			Pasadena			Little Rapids			Lark Harbour			Mount Moriah								
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	1.2	0.0	1.2	4.0	0.0	4.0	2.5	0.7	3.2	0.8	0.8	1.6	4.0	0.0	4.0						
2	2.0	0.0	2.0	6.0	0.0	6.0	3.4	0.0	3.4	2.0	5.2	7.2	5.0	0.0	5.0						
3	0.5	0.5	1.0	0.8	0.2	1.0	8.0	0.0	8.0	3.6	2.2	5.8	4.8	0.8	5.6						
4	0.8	0.4	1.2	3.0	0.0	3.0	4.8	0.0	4.8	6.0	2.0	8.0	1.4	0.0	1.4						
5	1.0	0.0	1.0	2.0	0.5	2.5	2.2	0.2	2.4	2.0	2.0	4.0	3.0	0.0	3.0						
6	2.8	0.0	2.8	4.8	0.2	5.0	0.8	0.8	1.6	2.0	0.0	2.0	0.8	0.8	1.6						
7	1.0	0.0	1.0	3.0	1.5	4.5	4.0	0.0	4.0	0.6	0.2	0.8	4.0	2.0	6.0						
8										1.4	0.0	1.4									
9										1.4	0.0	1.4									

Management Unit 16

	Deer Lake			Cormack			Sop's Arm		
1	1.6	0.4	2.0	10.0	3.0	13.0	3.5	4.0	7.5
2	2.0	2.0	4.0	2.0	2.0	4.0	2.5	0.0	2.5
3	2.4	2.8	5.2	4.4	0.4	4.8	6.0	0.0	6.0
4	4.0	2.0	6.0	8.5	0.5	9.0	3.0	3.0	6.0
5	1.6	1.6	3.2	1.2	0.4	1.6	2.5	0.5	3.0
6	1.0	0.0	1.0	4.0	0.0	4.0	2.8	1.0	3.8
7	6.0	0.0	6.0	3.0	1.0	4.0	4.0	1.0	5.0
8				1.0	0.0	1.0	9.0	3.0	12.0
9									

Management Unit 17

Interview Number	Daniel's Harbour			Eddies Cove West			River of Ponds			Shoal Cove West											
	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total	H	S	Total
1	4.0	0.0	4.0	12.0	3.0	15.0	4.0	12.0	16.0	0.6	0.4	1.0									
2	1.0	1.0	2.0	2.0	2.0	4.0	1.0	1.0	2.0	0.0	2.0	2.0									
3	3.0	0.2	3.2	12.0	5.0	17.0	1.0	5.0	6.0	0.8	0.0	0.8									
4	4.0	4.0	8.0	1.5	0.0	1.5	0.0	2.0	2.0	6.8	1.2	8.0									
5	0.8	0.0	0.8	1.0	0.0	1.0	2.0	4.0	6.0	2.8	5.6	8.4									
6	2.0	1.0	3.0				4.0	8.0	12.0												
7	3.0	3.0	6.0				6.0	3.0	9.0												
8																					
9																					

Management Unit 18

	St. Anthony			Goose Cove			Quirpon			Bide Arm			Conche			Anchor Point			Black Duck Cove		
1	0.8	5.0	5.8	0.0	10.0	10.0	0.0	2.0	2.0	1.0	3.0	4.0	0.0	10.0	10.0				0.4	1.6	2.0
2	1.0	2.0	3.0	2.0	2.0	4.0	2.0	7.0	9.0	4.0	5.0	9.0	1.0	8.0	9.0				0.0	0.8	0.8
3	1.5	1.5	3.0	0.8	0.8	1.6	2.0	2.0	4.0	0.0	10.0	10.0	1.0	1.0	2.0				2.0	0.8	2.8
4	0.5	4.0	4.5	0.8	1.2	2.0	0.0	2.4	2.4	5.0	0.0	5.0	2.0	15.0	17.0						
5	1.2	2.8	4.0	0.0	0.4	0.4	0.5	1.5	2.0	3.0	5.0	8.0	0.0	12.0	12.0						
6	0.5	3.5	4.0	0.0	3.0	3.0	0.4	0.4	0.8	0.0	3.0	3.0									
7	0.5	4.5	5.0				0.0	8.0	8.0	1.0	4.0	5.0									
8																					
9																					

APPENDIX 11

WOODFUEL: How Much Energy for Space Heating?

by M. H. Schneider,
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Articles, pamphlets and papers on wood heating frequently include values for heat available from wood when it is burned. Such values, I have noticed, are frequently unrealistically high, and often do not agree from one publication to another. This paper shows how such values are obtained, derives heating values for various species of wood from these methods, and compares them with some other fuels.

From basic studies, we know that completely burning an oven-dry pound of fuelwood to carbon dioxide and water, and having the products of combustion reach ambient temperature, yields 8,600 British thermal units (BTU).

The BTU's in one cubic foot of oven-dry wood is therefore

8,600 BTU per lb. x wood density

The energy content of an oven-dry cord would thus be

8,600 x wood density x no. of cubic feet in a cord

Many published tables of energy contents of various woods stop here, and thus are unrealistic. A few publications allow for water of combustion in the energy content calculation, giving a different set of unrealistic values for energy content.

The amount of useable space heating energy obtainable is the product of the combustion and heat-transfer efficiencies, and it is this value which is of interest to the user. Both efficiencies are widely variable, depending upon heater design, type and condition of wood fuel, heater installation, and the manner in which it is used. Good-quality, airtight heaters operated well with good fuel tend to have an overall efficiency (the product of the combustion and heat-transfer efficiencies) of about 50%.

This value is a result of testing of many good European and North American stoves by Dr. J. Shelton.[1] Dealers, manufacturers and sellers will often quote much higher efficiencies. This is because they are guessing, or they have some values for either the combustion or heat transfer efficiency exclusively. The user is interested in the amount of useable heat (determined from total efficiency) that he gets, not either of the other efficiencies alone.

The amount of useable energy from a cord of wood can be calculated from:

$$\text{Energy per cord} = 8{,}600 \times \text{cu. ft./cord} \times \text{density} \times \text{overall efficiency}$$

If a cord contains 80 cu. ft. of wood, and the overall efficiency is 50%,

$$\text{Energy per cord} = 344{,}000 \text{ (wood density)}$$

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[1] Shelton, J. and A. Shapiro. 1977. The woodburner's encyclopedia. Vermont Crossroads Press, Waitsfield, Vt.

Carrying out this calculation for some Eastern Canadian fuelwood, using average density values for the species in Canada[2] we get:

Species	Oven-dry Density lb./cu. ft.	Useable Heating BTU's/cord
Sugar maple (*Acer saccharum*)	43.7	15,000,000
Red oak (*Quercus rubra*)	41.2	14,200,000
White ash (*Fraxinus americana*)	40.6	14,000,000
Beech (*Fagus grandifolia*	43.7	15,000,000
White birch (*Betula papyrifera*)	37.0	12,700,000
Yellow birch (*Betula alleghaniensis*)	40.6	14,000,000
Elm (*Elmus americana*)	38.7	13,300,000
Red maple (*Acer rubrum*)	36.8	12,700,000
Poplar (*Populus* spp.)	26.2	9,010,000
Tamarack (*Larix laricina*)	33.7	11,600,000
E. Hemlock (*Tsuga canadensis*)	28.0	9,630,000
E. Spruce (*Picea* spp.)	25.0	8,600,000[3]
Balsam fir (*Abies balsamea*)	23.0	7,910,000[3]
E. White cedar (*Thuja occidentalis*)	19.3	6,640,000

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[2] From Kennedy, E. I. 1965. Strength and related properties of woods grown in Canada. Dept. of For. Publ. No. 1104.

[3] These species may be slightly higher because of their resin content.

In order to compare wood to other fuels, we must know the energy content of the fuel, and its overall space-heating efficiency. We know that a Canadian gallon of number-2 fuel oil, for example, contains about 167,000 BTU, and that an oil-fired furnace has an overall efficiency of approximately 65%.[4] Many tables of comparison between wood and oil do not take into account the efficiencies of burning each fuel, and some Canadian publications use the energy content of a U.S. gallon of oil in the calculation.

Canadian gallons of number-2 fuel oil equivalent to one cord of wood can be calculated from:

$$\frac{\text{Useable BTU per cord}}{167{,}000 \times 0.65}$$

Carrying out this calculation for a few species from the earlier table shows:

Species	Approx. fuel oil gallon equivalents to 80 cu. ft. cord
Sugar maple and beech	138
White birch	117
Balsam fir	73

Comparison with electrical-resistance heating is another useful example. This type of heating is virtually 100% efficient (in the space to be

---

[4]This depends upon furnace design, installation, duty cycle and maintenance. Values may range from quite low (below 50%) to perhaps 70%.

heated, but not in the generating plant), and the energy equivalent is approximately 3,400 BTU per kilowatt-hour of electricity. Thus the killowatt-hour equivalent to a cord of wood is:

$$\frac{\text{Useable BTU per cord}}{3{,}400}$$

Using the same species as for the oil comparison, we get:

Species	Approx. KWH equivalents to 80 cu.ft.cord
Sugar maple and beech	4,410
White birch	3,740
Balsam fir	2,330

Current prices for the various energy sources can be used to calculate comparative dollar values for these heating fuels at any particular time. Knowledge of the total heat energy requirement per year for a heated space allows cost comparisons on a yearly basis, and calculation of the amount of wood required to heat this space. For example, a typical single family dwelling in Eastern Canada may require about 100,000,000 BTU per year for space heating. Thus, for wood heat with beech or sugar maple, 6 2/3[5] cords would be required. If it cost $60 per cord, total heating cost would be $400. For the same amount of heat, 921[6] gallons of fuel oil would be required. At $0.55 per gallon, total cost would be $507. Electrical heating would require 29,500 killowatt hours, which at $0.035 per KWH, would cost $1,030.

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[5] $\frac{100{,}000{,}000}{15{,}000{,}000}$

[6] $\frac{100{,}000{,}000}{167{,}000 \times 0.65}$

True value of wood heating to an individual or family would depend upon many things, some tangible and some very difficult to evaluate in terms of dollars. Some of the tangibles include the capital cost of heating equipment, expected lifetime, and installation cost. They also include fuel costs. Using the methods outlined and values obtained in this paper, fuel costs, at least, can be evaluated and compared realistically.

The things which are currently not easily evaluated in terms of dollars, such as fuel renewability, pleasure, local availability (thus generating local economic activity), and potential for forest improvement may currently be more important than absolute cost comparisons when individuals are making choices about heating systems. In the long run, especially with more efficient and convenient wood-heating systems which can effectively supplement solar systems, the factors many now call intangibles will probably more readily lend themselves to numerical analysis similar to the costs of fuel and heating systems. I am quite certain that such analysis will reinforce decisions to heat with wood.

Note: The volume of a standard cord is 128 cubic feet. This includes wood, bark and air space. The solid wood content is variable, but 80 cubic feet is a good average.

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